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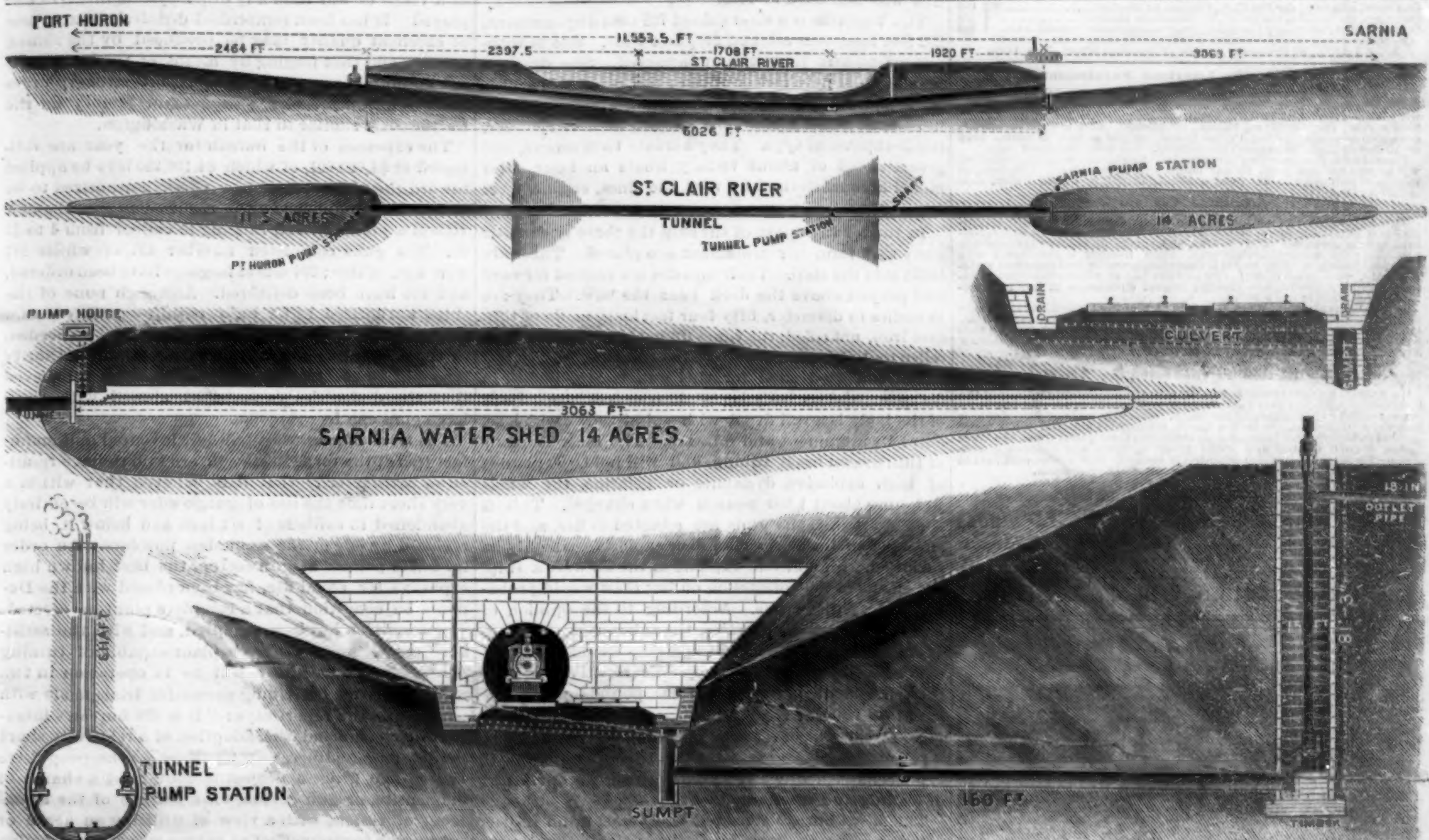

THE ST. CLAIR TUNNEL DRAINAGE SYSTEM.—[See page 373.]

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Contents.

(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 832.

For the Week Ending December 12, 1891.

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FAILURE OF THE DYNAMITE CRUISER VESUVIUS.

This novel type of war boat is declared by our best naval advisers to be of little use in her present condition, and it is recommended that she be altered into an ordinary torpedo cruiser.

The striking success which attended the experiments of Lieut. Zalinski in New York harbor, 1887, in throwing projectiles charged with dynamite from pneumatic guns located on shore, led to the belief that similar weapons might be successfully used on shipboard; and the government, anxious to possess itself of an arm that appeared to be at once novel and formidable, hurried forward the construction of the Vesuvius. She was launched in 1888.

The Vesuvius is a steel ship of 725 tons displacement, 252 feet long over all, and 26½ feet wide. She is without masts, and practically unarmored. She draws a maximum of nine feet of water; the mean draught is eight and one-half feet. Her engines, which have been illustrated and described by us, are of four-cylinder, triple-expansion type. They actuate twin screws, and give a speed of about twenty knots an hour. Her model is characterized by very fine lines, engines 4,000 horse power.

In the forward part of the ship the three pneumatic guns that form her armament are placed. These are built into the ship. Their muzzles are carried forward and project above the deck near the bow. They are 15 inches in diameter, fifty-four feet long, made of thin cast iron, not rifled, the vanes upon the projectile being relied on to give any desired axial rotation.

The full-sized shell for this gun is 14¾ inches in diameter, and its body is about seven feet long. Back of the body is a tail fitted with spiral vanes, which secures its alignment and rotation. The body is made of thin drawn brass tubing, and will hold 600 pounds of high explosive, dynamite or gelatine, the whole weighing about 1,500 pounds when charged. This is the largest shell the guns are adapted to fire, and the effects of such a heavy charge of explosive can only be surmised. Should one explode in the air over a ship, the effects of the concussion on her crew would probably be very disastrous. According to the opinion of students of torpedo practice, the submarine explosion of such a shell within 20 feet of a ship would destroy it.

The air by which the projectile is driven is compressed under a pressure of 2,000 pounds per square inch into tubular reservoirs.

No attempt has ever been made to test the guns with a full charge of the explosive, by reason of defects in the mechanism which render dangerous the operations of loading and discharge.

The naval bureau considers this vessel in no respect fitted as a gun platform for artillery of this description, even if the latter proved of any military value. It will be readily appreciated that, unarmored as the Vesuvius is, her stores of high explosives and a large portion of the length of her guns are completely exposed to the fire of rapid-fire ordnance. The effect of a single shell from a 1-pounder sent into her magazine of high explosives may be imagined.

The vessel, as is well known, possesses only indifferent steering qualities, and, this being the case, it is probable that two torpedo boats of the type of the Cushing, armed with an automobile torpedo and with rapid-fire guns of smaller caliber, would very much overmatch her. It is considered, therefore, that the question of the value of the guns for war purposes should receive an early conclusion.

It is believed that the range of efficiency of the Vesuvius would be greatly increased by turning her into a torpedo cruiser. Her displacement is such that, with her dynamite guns removed and a battery of considerable power placed for fore and aft fire, supplementing the larger calibers of rapid-fire guns with a number of 6-pounders, this vessel would then become a formidable antagonist for any of the unarmored types.

Her tubes, however, would be useful should they pass the necessary test for shore stations, or perhaps for a moored battery in harbor defense. The number of these weapons ordered for the land fortifications at New York, Boston, and San Francisco will also give opportunity to thoroughly investigate their value under more favorable circumstances than exist on board the Vesuvius.

HEAVY GUNS AND THE BEST ARMOR.

As the result of the efforts made during the last half dozen years, the position of the country as to means of offense and defense has been vastly improved. Not only have we the fine new vessels of the white squadron, with many other and more formidable ships approaching completion, but in the manufacture of heavy guns and armor we have about passed the experimental stage, and in several private establishments, as well as in the government shops, are now turning out both guns and armor believed to be equal to or better than any made heretofore in Europe. The experiments which have been made in the testing of armor and armor-piercing projectiles, in trials of smokeless and other powders, and as to the service possibilities of various types of guns and gun carriages, have been carried out with great thoroughness, and the work of production is now being pushed in American shops and by our own skilled mechanics.

In the recent report of Commodore Folger, chief of the Bureau of Ordnance, an interesting account is given of the armor tests conducted during the year, and the report says the bureau considers that two important results have been achieved: First, a better plate, of American manufacture, has been produced than the department was able to purchase abroad a year ago; secondly, it has developed a new principle in the manufacture of armor, of American origin, which will furnish greater protection to the vital parts of a vessel of war than any other system hitherto employed. It has been established definitely that armor of excellent quality may be produced by the rolling process, and that forging by means of the hammer is not absolutely necessary. The report strongly urges the establishment of a national gun factory on the Pacific coast similar to that in Washington.

The expenses of the bureau for the year are estimated at $4,780,291, of which $4,186,250 is to be applied toward the armament of new vessels authorized to be built. The number of guns required to arm the new vessels is placed at 347, ranging in caliber from 4 to 13 in. The guns completed number 155, of which 117 were 6 in. caliber; 294 sets of forgings have been ordered, and 246 have been delivered. Although none of the ships authorized to be built requires guns of 16 in. caliber, it is believed that such guns may be needed, so the necessary plans have been made, and authority is sought for construction of one of them. It is believed that the difficulties experienced abroad with these large guns can be overcome.

The trials of smokeless powder, invented and manufactured at the torpedo station, are said to have resulted so satisfactorily that it is believed that within a very short time the use of gunpowder will be entirely abandoned in calibers of six inch and below it, being replaced by one of the smokeless powders. An order for 50,000 pounds of gun cotton, the best known high explosive for naval use, has been placed with the Duponts on condition that a complete plant be erected. The condition has been accepted, and with the assistance of the naval experts a plant capable of turning out 1,000 pounds a day will be in operation in two months. After describing successful trials made with emmensite, the report says: "It is the bureau's intention to recommend the adoption of a relatively short gun of large caliber, using powder as the propulsive charge and firing a projectile containing a charge of emmensite, or gun cotton, for a feature of the armament of vessels, with a view of utilizing an aerial or submarine torpedo effect at ranges where the question of accuracy of fire is absolutely eliminated."

After recounting the efforts made to secure an effective automobile or fish torpedo, the report says: "The present state of work, in connection with automobile torpedoes and their accessories, is such as to justify the belief that the installation of outfits on board vessels will commence early in the coming year, and that our navy will soon be equipped with torpedo outfits equal, if not superior, to those possessed by foreign nations." Touching the submarine gun now approaching completion, the report says: "A further consideration of the subject of submarine artillery inclines the Bureau to the belief that it will prove a valuable and important adjunct to our defensive armament, particularly when mounted on board of vessels intended especially for ramming. It seems possible that the chances of the ram being able to reach her antagonist with destructive effect will be quadrupled by the addition of this weapon to her means of offense."

Under the head of armor it is announced that negotiations are in progress to cause the plate to be delivered by the Bethlehem Company for the double turret monitors and the Maine and Texas to be of nickel steel. The armor ordered from Carnegie, Phipps & Co. is to be of the same material, the department supplying the nickel; 800 tons of ore for that purpose were purchased last year.

Public School Finances.

The public school finances of thirty-one States have now been published by the Census Bureau. The census bulletins Nos. 54, 98, and 141 contain these interesting statistics. They give the number of pupils enrolled, amount expended on salaries and miscellaneous accounts, and total expenditures. These are given in sum totals and reduced to sums expended per capita of pupils enrolled, and the total expenditures are also reduced to sums per capita of population. Many other tabulations of the money employed in the various functions of the public school system are also given. To all interested in education and the much-debated public school system these figures will be of the highest interest. Curious instances of the wide range of expenditure occur. Alabama is given as expending but $1.85 per capita of pupils against Massachusetts' $17.27 and Colorado's $16.40. The total expenditure per capita of population does not fluctuate so widely, Alabama spending $0.37 against $4.08 in Colorado.

Decisions of the Courts Relating to Patents.
Supreme Court of the United States.

ADAMS v. BELLAIRE STAMPING COMPANY *et al.*

Decided November 16, 1891. Mr. Justice Field delivered the opinion of the court.

The claim of a patent for an improvement in lanterns was for securing a removable lantern top to the upper part of the guard by means of a hinge connecting it thereto, and on the side opposite the hinge a removable fastening or spring catch, which when detached allowed the top of the lantern to open and swing back upon the hinge. Upon an action for infringement, *Held* invalid for want of patentable novelty.

An aggregation of old devices, each working out its own effect, without securing some new and useful result as the joint product of the combination, does not constitute a patentable invention. (Quoting Hailes v. Van Wormer, 20 Wall., 353, and Pickering v. McCullough, 104 U. S., 310.)

Where the question is upon the patentable character of the invention, evidence that it had practically superseded all other devices of its kind and tending to establish novelty is not material. Where there is no invention, the extent of use is not a matter of moment.

PATENT CLOTHING COMPANY, LIMITED, v. GLOVER *et al.*

Decided November 16, 1891. Mr. Justice Brewer delivered the opinion of the court.

The claim of an original patent was for an inelastic bridge or check piece arranged across the crotch of pantaloons, whereby the strain is received by this bridge or check piece, instead of at the angle of the crotch itself. The reissue contained two claims, and in an action brought for its infringement it was successfully contended by the defendant in the lower court that the reissue was broader than the original patent. *Held* that this is an immaterial question, because both the original patent and the reissue are invalid for want of patentable novelty.

The idea of the patentee was to add to the strength of the thread the strength of a piece of cloth, and this he did by a strip crossing the crotch as a bridge, and running up along the button and button hole strips, and fastened to them respectively.

But this was no new idea. It is as old as pantaloons themselves. It has been illustrated in the experience of every boy, for in his sports he not infrequently tears his pantaloons, and his good mother, not content with sewing the torn ends together, and thus holding them by the direct strength of the thread, is wont to place underneath a piece of cloth, and fasten it to the main body of the garment for some distance on either side of the tear. In this way the whole strain, which otherwise would be solely on the threads closing the tear, is largely borne by the new cloth underneath. Surely when this idea is so well known, and been so practically illustrated for generations, it cannot be that there was any exercise of the skill of an inventor in applying the same process to any part of the pantaloons.

The Electrical Atom.

At the recent dinner of the Institution of Electrical Engineers, London, Professor William Crookes, the president, said:

We have happily outgrown the preposterous notion that research in any department of science is mere waste of time. It is now generally admitted that pure science, irrespective of practical applications, benefits both the investigator himself and greatly enriches the community. "It blesseth him that gives, and him that takes." Between the frog's leg quivering on Galvani's work table and the successful telegraph or telephone there exists a direct filiation. Without the one we could not have the other.

We know little as yet concerning the mighty agency of electricity. "Substantialists" tell us it is a kind of matter. Others view it, not as matter, but as a form of energy. Others, again, reject both these views. Professor Lodge considers it "a form, or rather a mode of manifestation, of the ether." Professor Nikola Tesla demurs to the view of Professor Lodge, but thinks that "nothing stands in the way of our calling electricity ether associated with matter, or bound ether." High authorities cannot even yet agree whether we have one electricity or two opposite electricities. The only way to tackle the difficulty is to persevere in experiment and observation. If we never learn what electricity is, if, like life or like matter, it should remain an unknown quantity, we shall assuredly discover more about its attributes and its functions.

The light which the study of electricity throws upon a variety of chemical phenomena—witnessed alike in our little laboratories and in the vast laboratories of the earth and the sun—cannot be overlooked. The old electro-chemical theory of Berzelius is superseded, and a new and wider theory is opening out. The facts of electrolysis are by no means either completely detected or co-ordinated. They point to the great probability that electricity is atomic, that an electrical atom is as definite a quantity as a chemical atom. The electrical attraction between two chemical atoms, being a trillion times greater than gravitational attraction, is probably the force with which chemistry is most deeply concerned.

It has been computed that, in a single cubic foot of the ether which fills all space, there are locked up 10,000 foot tons of energy which have hitherto escaped notice. To unlock this boundless store and subdue it to the service of man is a task which awaits the electrician of the future. The latest researches give well founded hopes that this vast storehouse of power is not hopelessly inaccessible. Up to the present time we have been acquainted with only a very narrow range of ethereal vibrations, from extreme red on the one side to ultra violet on the other—say from 3 ten-millionths of a millimeter to 8 ten-millionths of a millimeter. Within this comparatively limited range of ethereal vibrations, and the equally narrow range of sound vibrations, we have been hitherto limited to receive and communicate all the knowledge which we share with other rational beings. Whether vibrations of the ether, slower than those which affect us as light, may not be constantly at work around us, we have until lately never seriously inquired. But the researches of Lodge in England, and Hertz in Germany, give us an almost infinite range of ethereal vibrations or electrical rays, from wave lengths of thousands of miles down to a few feet. Here is unfolded to us a new and astonishing universe—one which it is hard to conceive should be powerless to transmit and impart intelligence.

Experimentalists are reducing the wave lengths of the electrical rays. With every diminution in size of the apparatus the wave lengths get shorter, and could we construct Leyden jars of molecular dimensions the rays might fall within the narrow limits of visibility. We do not yet know how the molecule could be got to act as a Leyden jar, yet it is not improbable that the discontinuous phosphorescent light emitted from certain of the rare earths, when excited by a high tension current in a high vacuum, is really an artificial production of these electrical rays, sufficiently short to affect our organs of sight. If such a light could be produced more easily and more regularly, it would be far more economical than light from a flame or from the arc, as very little of the energy in play is expended in the form of heat rays. Of such production of light, nature supplies us with examples in the glow worm and the fireflies. Their light, though sufficiently energetic to be seen at a considerable distance, is accompanied by no liberation of heat capable of detection by our most delicate instruments.

By means of currents alternating with very high frequency, Professor Nikola Tesla has succeeded in passing by induction through the glass of a lamp energy sufficient to keep a filament in a state of incandescence without the use of connecting wires. He has even lighted a room by producing in it such a condition that an illuminating appliance may be placed anywhere and lighted without being electrically connected with anything. He has produced the required condition by creating in the room a powerful electrostatic field alternating very rapidly. He suspends two sheets of metal, each connected with one of the terminals of the coil. If an exhausted tube is carried anywhere between these sheets, or placed anywhere, it remains always luminous.

The extent to which this method of illumination may be practically available, experiments alone can decide. In any case, our insight into the possibilities of static electricity has been extended, and the ordinary electric machine will cease to be regarded as a mere toy.

Alternating currents have at the best a rather doubtful reputation, but it follows from Tesla's researches that as the rapidity of the alternation increases they become not more dangerous, but less so. It further appears that a true flame can now be produced without chemical aid—a flame which yields light and heat without the consumption of material and without any chemical process. To this end we require improved methods for producing excessively frequent alternations and enormous potentials. Shall we be able to obtain these by tapping the ether? If so, we may view the prospective exhaustion of our coal fields with indifference. We shall at once solve the smoke question, and thus dissolve all possible coal rings.

Electricity seems destined to annex the whole field not merely of optics, but probably also of thermotics.

Rays of light will not pass through a wall, nor, as we know only too well, through a dense fog. But electrical rays of a foot or two wave length of which we have spoken will easily pierce such mediums, which for them will be transparent.

Another tempting field for research, scarcely yet attacked by pioneers, awaits exploration. I allude to the mutual action of electricity and life. No sound man of science indorses the assertion that "electricity is life;" nor can we even venture to speak of life as one of the varieties or manifestations of energy. Nevertheless, electricity has an important influence upon vital phenomena, and is in turn set in action by the living being—animal or vegetable. We have electric fishes—one of them the prototype of the torpedo of modern warfare. There is the electric slug which used to be met with in gardens and roads about Hornsey Rise, there is also an electric centipede. In the study of such facts and such relations the scientific electrician has before him an almost infinite field of inquiry.

The slower vibrations to which I have referred reveal the bewildering possibility of telegraphy without wires, posts, cables, or any of our present costly appliances. It is vain to attempt to picture the marvels of the future. Progress, as Dean Swift observed, may be too fast for endurance. Sufficient for this generation are the wonders thereof.

Photomicrography.

The importance of modern photography as applied to microscopic objects is forcibly brought out by the following remarks made by Prof. Robert Koch, the eminent bacteriologist, who employs photography with great success to bring out the most minute parts of organic and inorganic bodies.

Prof. Koch likens the negative plate to a human eye not blinded by a sharp light nor tired out by long-continued examinations.

"The negative," says Prof. Koch, "frequently shows very fine bodies and parts, which are afterward discovered by the microscope on the object itself, but only after very hard work and under the most favorable conditions regarding light, etc.

"Accurate measurement of but faintly visible objects is almost impossible under the microscope, but on the finished negative the task is rendered comparatively easy. The photographic picture of a great many objects is frequently of more importance than the object itself. If I gave to somebody a prepared specimen for viewing certain parts of the same under the microscope, for instance, lymph vessels containing bacteria, then I am not certain that the party has found the right spot, and if this is the case, I am not positive that he is viewing the part under the same light and conditions as I did. A photograph, however, gives the microscopic picture exactly in the same light, the same enlargement, etc., as I viewed it at the time of focusing it.

"It is very simple to explain the photogram to a number of persons at the same time, as one can point with the finger to a particular part, or measure it with the compass, or compare it with other similar photographs placed alongside of it, in short, you can do almost anything in order to come to an understanding over a disputed part."

Colorado Oil.

A recent paper on "The Florence Oil Fields of Colorado," by Geo. H. Eldridge, of the United States Geological Survey, says:

The locality is situated on the Arkansas River near Canoro City, and 30 miles from Pueblo, Col. The oil-bearing zone occurs in the Pierre formation, the lowest strata of the Montana group of cretaceous rocks, which is here about 4,000 feet thick. The most productive wells are 1,155 feet below its top, or 2,000 feet from the surface. There is then about 350 feet of barren ground, and then more oil is found. Below this is again 350 feet of barren ground, and finally, at the bottom of the zone, there are some small wells. The oil seems to have originated in the Pierre rocks. The percentage of producing wells to the number bored is 57½, and the wells yield from 5 barrels up to 250 barrels per day. The total yield of the district in 1890 was about 1,200 barrels per day, but the wells could yield 2,000 barrels per day of 31° Baume oil. Out of 300,000 barrels of crude oil there was produced last year 100,000 barrels of illuminating and 5,000 barrels of lubricating oil.

"The Thrift."

"The Thrift" is a species of banking association, instituted under the auspices of the Pratt Institute, of Brooklyn, N. Y., for the purpose of encouraging people in economical habits, and to train up the young especially in the right use of money. The central office is in the Pratt Institute. It includes an investment branch, in which interest is given on account of regular installment deposits, at the rate of about 6 per cent per annum; a deposit branch giving interest on deposits made at any time under stated regulations; and a loan branch, designed to encourage the acquirement and building of homes, somewhat as in building and loan associations. The security includes a first mortgage on the property and assigned life insurance equal to one-half the amount of the loan. An explanatory circular has been issued, explaining more at length the workings of the association, and it is evident that its capacity for good is very great.

To Harden Iron all Through.

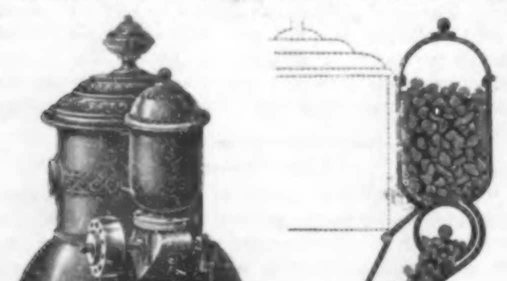
Ox hoofs and leather are soaked in French nut oil, and are then burnt, pulverized, and mixed with sea salt and potash. The following proportions are used: 30 per cent of hoofs, 30 per cent of leather, 30 per cent of sea salt, 10 per cent of potash. This product is said to harden iron all through.

The Great Railway Station, Jersey City.

The new terminal station of the Pennsylvania Railroad, Jersey City, N. J., opposite New York City, has the largest train shed in the world, surpassing that of the St. Pancras terminal of the Midland Railway, in London. It is 652 feet 6 inches long, 256 feet wide, 86 feet clear height at the center, and 110 feet from rail level to top of skylight. The structure consists of twelve pairs of main roof trusses, 252 feet 8 inches between centers of end pins, with the lower chord or tie rod running across under the platforms. The trusses are of riveted connection, and are hinged at each foot and at the apex to allow for contraction and expansion. The ends are filled in with glass, and half of the roof area is of glass, with wire netting inside to prevent the fall of glass in case of breakage. Along the apex of the trusses is a large skylight, with open sides for ventilation, and there is also a skylight along each side of the main arch. The radius of the outer line of the main arch trusses is 215 feet at the sides and 150 feet at the middle, while the inner line is 125 feet radius at the middle, 162 feet 6 inches at the sides and 45 feet to the platform level. There are twelve tracks, arranged in three double-track and six single-track lines, with platforms 12 feet 2 inches to 22 feet wide. The station is approached by a four-track plate girder deck elevated viaduct, which has already been described, as well as the complete switch and signal and interlocking plant. A station and office building will be erected, the former having waiting, refreshment, and ticket rooms, etc., and the latter a five-story building for the general offices of the New York division of the road. The railway platforms are about on a level with the upper decks of the new ferry boats connecting with New York across the river.

A FEEDER FOR STOVES AND FURNACES.

A device designed to automatically feed a desired amount of fuel at regulated intervals to a stove or furnace, and which will also shake the grate to prevent the accumulation of ashes, is shown in the accompanying illustration. It has been patented by Mr. William Jones, of No. 2531 Bloomington Avenue, Minneapolis, Minn. The hopper has a lower opening leading into a chute which delivers into the fire pot, the inner end of the chute being closed by a swinging door when the coal is not passing, so that gas from the fire pot cannot escape by this channel. A shaft extending through the upper portion of the chute carries a cylindrical bucket, turning immediately beneath the mouth of the hopper, and which has on one side an opening admitting coal from the hopper, the coal being discharged from this opening down the chute when the bucket is turned over, as shown in the sectional view. A tongue pivoted in the lower portion of the hopper extends over the edge of the opening to prevent the coal in the bucket from clogging and facilitate the rotation of the bucket. On one end of the bucket shaft, within a suitable casing, is a clock-work mechanism to turn the shaft, the mechanism being operated by a simple form of spring motor which can be easily adjusted to run as fast or slow as desired, according as the feed is to be regulated, this being effected by sliding in or out the blades of a fan, thus causing an increased or diminished air pressure. It is preferred that the bucket be not too large, and be made to turn comparatively often, thus supplying small quantities of coal at frequent intervals. On the other end of the bucket shaft is a crank connected by a rod with a block engaging the longer

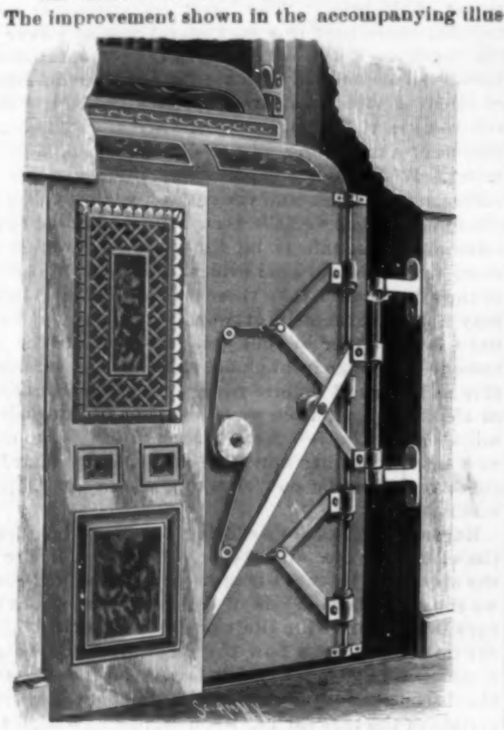


JONES' FEEDER FOR STOVES AND FURNACES.

arm of a bell crank to operate a grate-shaking attachment. The grate does not tip, but oscillates, and has a laterally extending jointed arm supported in a longitudinal slot, this arm being connected with the short arm of the bell crank. The longer arm of the bell crank has at its free end a weight, and this arm is designed to be raised and dropped by the revolution of the bucket shaft, causing the oscillation of the grate from the connection of the latter with the short arm. To give the grate more of a vibrating movement, a spring is arranged at one end of the slot through which the arm of the grate extends, the opposite pressures of the spring and the weight acting to increase the movement of the grate, whereby it will be effectively shaken, to keep the fire free from ashes, each time a charge of fuel is delivered into the fire pot.

AN ELEVATOR DOOR OPERATING DEVICE.

The improvement shown in the accompanying illus-



BUTLER'S ELEVATOR DOOR OPERATOR.

tration is designed to automatically close the door of an elevator shaft, in conjunction with an ascending or descending car. It forms the subject of a patent issued to Mr. Louis W. Butler, of No. 1 Broadway, New York City. Upon the front of the car, and held slightly out from it by end and intermediate bearings, is a vertical rod, upon which slide four sleeves, arranged in pairs, to which the ends of levers are pivoted, the levers of each pair of sleeves being pivotally connected. The sleeves bear at their inner ends against the intermediate bearings, and when the levers are pressed toward the rod the sleeves of each pair slide up and down, the levers tending to assume a vertical position. The levers are normally held in their triangular position, as shown, by a spring-actuated drum pivoted on a stud, a cord or chain wound around the drum and passing over guide pulleys being connected at one end with the upper set of levers and at the other end with the other set of levers. Upon the inner wall of the elevator shaft, and preferably a slight distance above the shaft opening, is held another rod, on which slides the sleeve of a door-shifting rod, the lower end of which is pivoted to the rear edge of the door near the bottom, while on the inner side of the rod a friction roller is journaled upon a stud, and the rod is pivotally connected by a link with a lower sleeve on the rod held on the shaft wall. In operation, as the car moves up or down, in passing a closed doorway, the friction roller easily presses in the levers sufficiently to allow the car to pass without moving the door. When the car stops at a floor the friction roller stands between the two sets of levers, and the door may be readily opened. When the car commences to ascend, the door being open, the shifting lever will be in a nearly vertical position, and the friction roller on the lever will then contact with the upper lever of the lower set and travel out on its inclined surface to force the door to a closed position. If the car is going down, the contact will be upon the lower lever of the upper set, the door being closed by a similar movement in both cases. The tension of the spring in the drum connected with the levers is such that, should any one entering or leaving a car be caught between the door jamb and the door, no serious injury will be inflicted, as the door may be readily forced back against the tension of the spring.

The Rain-Making Experiments.

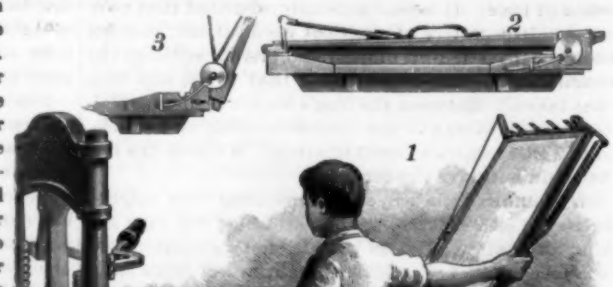
A letter from a citizen of Texas who witnessed the recent Dyrenforth rain-making experiments in that State pronounces them the most veritable humbugs and absurd waste of public money of which it is possible to conceive. He says that the trial party were shrewd enough not to begin operations before the season when, from time immemorial, rain has come down plenty and often in that region. In his belief, too, unwarranted claims and representations were sent out as to the results of the experiments.—*Boston Journal.*

Testing Oil of Turpentine.

G. Vulpius finds that reliable determinations of petroleum in turpentine oil may be made by the following modification of a method proposed by Hinsdale: 1 gramme of the sample and 1 gramme of a pure oil of turpentine are weighed on separate watch glasses, which are then floated on a basin of water maintained at about 80° C. As soon as the pure turpentine has evaporated, both watch glasses are weighed. The weight of the residue from the pure oil of turpentine (small quantity of resin always present in pure turpentine) is deducted from that of the residue in the watch glass which held the sample. The difference is petroleum, which may thus be determined to one-tenth of a per cent.

AN AUTOMATIC FRISKET FOR PRINTING PRESSES.

The improvement shown in the accompanying illustration is designed to facilitate the keeping of a perfect register in doing work on hand presses, while saving the pressman the labor of operating the frisket. It has been patented by Mr. Lorenzo D. Clark, of Fort Jones, Cal. The large view represents a press to which this improvement has been applied, Fig. 2 being a side view of the bed only with the tympan folded down upon it, and Fig. 3 being a partial section of the device in open position. At one side of the bed, adjacent to the tympan, is adjustably secured a shoe, having a vertical offset or ear with a cam surface. Near the lower end of the tympan a shaft is transversely journaled in three bearings, the bearings being so constructed as to admit of adjustment to any size of form. Upon the end of the shaft projecting over the offset of the bed shoe, is a disk, provided with a wrist pin projecting from both its faces, the inner portion of the pin being adapted to ride upon the cam surface of the offset, while the outer end of the pin is connected by a curved link with the ear of the bed shoe. One end of the link is pivoted to the pin, and its other end is bent to form a hook, and has a sliding connection with the ear, whereby the link will draw upon the wrist pin to turn the disk and its shaft when the tympan is being thrown back, but will slide freely in a slot in the ear as the tympan is being put down. Upon the opposite end of the disk-carrying shaft is a head block, with a perforation at each end to receive a connecting rod, the other end of each rod being similarly connected to a head block on the end of a shaft journaled on the tympan near its top. The rods cross each other near their central portion, where they pass through guide sleeves, the crossing of the rods causing the shafts to be rotated in opposite directions, and the upper shaft has at its opposite end a crank arm, which is pivotally connected by a link with a spring, the tension of which is away from the tympan. Each of the shafts at the top and bottom of the tympan is provided with grippers, and as the tympan is put down, after a sheet has been placed in position, the pin on the inner side of the disk engages the cam of the bed shoe, whereby the disk is revolved and both shafts are turned, the tension of the spring then operating to press the grippers firmly upon the sheet. When the tympan is raised, the link connecting the bed shoe with the disk causes the shafts on the tympan to be revolved sufficiently to release the grippers, when the tension of the spring, as the crank arm to which it is connected is carried over the center of its radius, holds the grippers open. It is also designed, where desired, to use guard strips in connection with the gripper



CLARK'S FRISKET FOR HAND PRESSES.

shafts, to prevent the soiling of the sheets, the guards being so placed as to stand out at an angle when the tympan is raised, and not interfere with the work of the pressman.

A MOST important feature of the scientific instruction in the lower grade of schools should be the collection of specimens which should form the subject of object lessons.

THE LARGEST OF OUR NEW WAR SHIPS.

Larger by about fifteen hundred tons than any vessel ever before launched from a United States shipyard, the new cruiser New York, named in honor of the Empire State, smoothly slipped from her ways at the Cramp shipyards into the waters of the Delaware, on Wednesday, December 2. The launch as an interesting spectacle, and one invoking a degree of patriotic ardor, was in every way a splendid success. It was viewed by scores of thousands, and there were numerous representatives present from the highest official circles. The shipyard where the launch took place has acres of shops amply provided with lathes, forges, furnaces, derricks, etc., and three other formidable ships for the new navy now being built there, on which the work is well advanced, contributed not a little to the feeling of unalloyed satisfaction which the occasion brought out.

The new ship is said to have been the especial pride of the Navy Department, having great offensive and defensive qualities, a high rate of speed, and great coal endurance, and it was remarked, as she lay on the ways, that her sharp, graceful lines suggested the speedy transatlantic liner rather than a ship of war. Three firms bid for the construction of this vessel, as follows: Class 1. Hull and machinery, including engines, boilers and appurtenances, complete in all respects in accordance with the plans and specifications provided by the Navy Department—William Cramp & Sons, of Philadelphia, $3,150,000; Union Iron Works, of San Francisco, $3,100,000; Risdon Iron and Locomotive Works, San Francisco, $3,450,000. Class 2. Hull and machinery, including engines, boilers and appurtenances, complete in all respects in accordance with the plans and specifications provided by the bidder, guaranteeing strength of materials, displacement, speed, etc.—Union Iron Works, of San Francisco, $3,000,000; William Cramp & Sons, of Philadelphia, $2,985,000. The proposal of William Cramp & Sons to build the vessel, under the second classification, for $2,985,000, being the lowest received was accepted, and a contract was entered into on August 28, 1890. The modifications included a rearrangement of the boilers, so that additional longitudinal and transverse bulkheads could be fitted in the engine and boiler spaces, thereby affording greater protection to the machinery and making the boilers less vulnerable to attack from rams and torpedoes. The keel was laid on September 30, 1890, and the contract requires that the vessel shall be finished and ready for delivery to the United States on or before January 1, 1893.

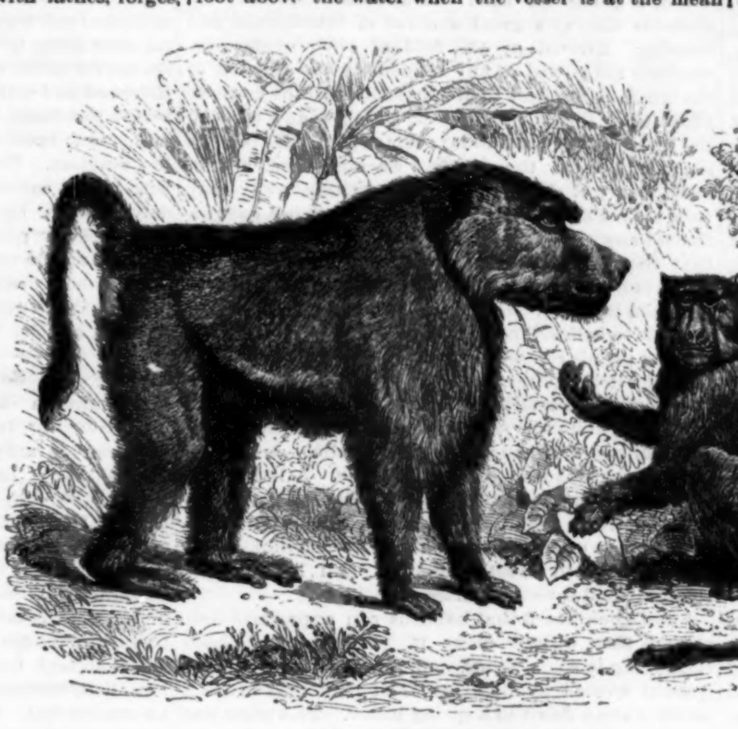
The length of the New York is 380 feet and 6½ inches; breadth of beam, 64 feet; mean draught, 23 feet and 3½ inches; displacement, 8,150 tons. Her highest speed is to be 20 knots an hour, and the sustained sea speed 18·5 knots. With 1,500 tons of coal in her bunkers and stored on deck, she will be able to steam 13,000 miles at the rate of 10 knots per hour. She has the ram bows and high freeboard of the large cruisers, but her stern is lighter, indicating the effort to produce a speedy model. Having a high freeboard, her guns may be worked in a seaway, the 8 inch rifles being 25 feet above water. In the absence of sail power, the entire dependence must be on her twin screws. The two masts are for fighting and signaling purposes, and are to be provided with protected tops. She has four decks, including the protective deck and a flying deck, or bridge, for boats.

The materials used in the construction are of the best quality. The outer steel plating amidships is 23 pounds to the square foot from keel plate to shear strake, which is 46 pounds. Toward the extremities the outer plating is lighter. Between the protective and berth decks the plating is doubled in the wake of the thin armor. The keel plate is 15 pounds to the square foot, and the plates of the main bulkheads have the same weight. The protective deck at the sides is 4 feet and 9 inches below the water amidships and 1 foot above the water when the vessel is at the mean draught. It is covered with two courses of plating, 3 inches in thickness amidships and 2½ inches fore and aft. The slopes amidships have an additional thickness of 3 inches, making a total thickness of 6 inches. In the wake of the machinery is a belt of thin armor between the protective and berth decks, the total thicknesses of armor on the sides being 6 inches. A coffer dam, 3 feet and 6 inches in depth, between the protective and berth decks, and extending the entire length of the vessel, is to be filled with a water-excluding material.

In her armament the main battery is to consist of more but lighter rifles than the Maine's. She is to have six eight inch breech loading rifles and twelve four inch rapid fire guns. In the secondary battery are to be eight rapid fire six pounders, four rapid fire one pounders and four Gatling guns. Of the six torpedo tubes, one is to be in the bows, one in the stern, and two are to be on each broadside.

Two of the eight inch rifles are to be mounted in a barbette forward on the upper deck, two in a similar barbette aft, and two are to be carried in broadside amidship on the upper deck. The men working the rifles in the barbettes are to be protected by ten inches of steel armor, and the revolving conical shields of steel are to be seven inches in thickness. The big rifles amidships are to be protected by partial barbettes two inches in thickness. The four inch guns on the spar deck are to have sponsons four inches in thickness and are to be protected by shields. The men at the six pounders are to be protected by eight inches of armor. The sloping armor beneath the barbettes is to be five inches in thickness, and the ammunition tubes below are to be five inches also.

Her motive power will be twin screws, driven by four vertical direct-acting triple expansion engines located in four water tight compartments. The diameters of the cylinders of each engine are 32, 46, and 70 inches respectively, and the stroke is to be 42 inches. For the great speed expected the screws must make 129 revolutions a minute. It is estimated that the collective indicated horse power of propelling, air pump and circulating pumps will be 16,000. The steam for the engines is to be supplied by six double ended main boilers arranged two abreast in three water tight compartments, with six athwartship fire rooms. Each is to be fifteen feet six inches in diameter and twenty-one feet three inches in length. They are to be worked under forced draught on the air tight fire room system. The lighting is to be by electricity, and the search lights are to have the latest improvements. She is to be fitted as a flagship, and a large and valuable library is to be given the ship by a New York merchant, while a large sum has been raised to present her with a handsome service of plate.



THE CHACMA.

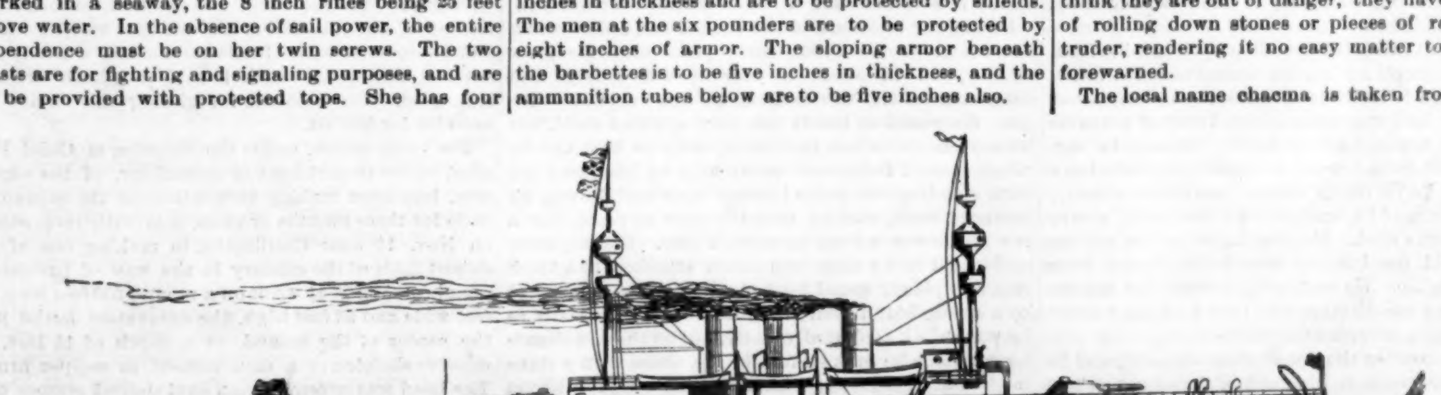
THE CHACMA OR SOUTH AFRICAN BABOON.

BY NICOLAS PIKE.

Africa is especially the native country of baboons. Of all the quadrumani they are about the ugliest, chiefly those of the genus *Cynocephalus*. A curious fact is that out of over fifty species of apes, monkeys, and baboons inhabiting Africa, there are said to be only one or two known instances of an African species occurring in Asia or an Asiatic one in Africa. The one I am about to write of is the *chacma*, or *C. porcarius*. This animal is met with in most of the southern ranges of mountains from the tropic of Cancer to those of the Cape colony. Even in the great Sneeuwberg range, where snow rests on some of the peaks the year round, troops of baboons are met with quite as numerous as those of the lower forest lands. Table Mountain, so conspicuous a feature rising above Cape Town, and grandly visible as you approach it from the sea, used to swarm with large and formidable troops of these creatures, whence they swooped down on the lands of the poor farmers, doing irreparable damage to their crops. As the country round Cape Town has become settled and many of the baboons been killed, they, like so many other animals, have receded before civilization.

In the kloofs or rocky passes of the mountains, where there is not much traffic, fifty or sixty may be seen stretched out, basking in the sun. At the slightest noise or disturbance they are on the alert and their howlings and screams of defiance resound along the hills. They inhabit the dense forests, also where there are ledges of rock, for their habits and structure prevent their easily climbing trees. They prefer steep overhanging cliffs, and if surprised at their base, readily mount them by clinging to the giant *lianes* that form a network over them. Hand over hand they go up, and many species of these plants go by the name of "bavians touw," or baboon's ropes, from the use they make of them. When half way up and they think they are out of danger, they have an ugly habit of rolling down stones or pieces of rock on the intruder, rendering it no easy matter to escape, if not forewarned.

The local name chacma is taken from an old Hot-



THE NEW ARMORED CRUISER NEW YORK, LAUNCHED DECEMBER 2.

tentot word *T'chackamma*, given with a peculiar *click* of the tongue, unpronounceable by white men except in rare instances by those brought up in the colony. This click runs through the whole Hottentot language and that of many of the Kafir tribes. It is not often heard now from the Hottentots, as the old small race is fast dying out. Curious to say, the constant admixture of white blood has developed a large and good-looking race, and these "bastard Hottentots," as they are called, use a medley of low Dutch and English, or the latter entirely.

The ordinary food of the chacma consists of bulbous roots, which they dig up and peel adroitly, berries, wild grapes, and even grass when pressed by hunger. They eat greedily of all kinds of insects; especially are they fond of locusts, of which so many species abound in the Cape, and they are also credited with sucking birds' eggs, and destroying the young. Unfortunately they do not confine themselves to such food as nature provides, but will travel long distances to raid the farm lands wherever melies or Indian corn, millet, oats or pumpkins are planted.

The generic name of *Cynocephalus* was given to the chacma by Cuvier; from two Greek words signifying dog and head, the prolonged truncated muzzle resembling that of a dog, and having the nostrils at the extremity. Their small, deep set eyes, with white upper eyelids and projecting brows, give them an indescribable look of ferocity and cunning. The males are large and robust, and when angry display their great canine teeth, which gives them so fierce an aspect, and the old ones would be most formidable foes to tackle, as they could tear a man to pieces like a tiger. When young they can be easily tamed and are quite playful. They are said to guard a house even better than a dog, giving instant notice of the approach of a stranger. They are seven or eight years old before they are full grown, when with few exceptions the old ferocity begins to develop itself and they are most uncertain of temper. When adult they are far too dangerous to have loose around, as they rarely attach themselves to more than one person, and even with him, on the slightest provocation, they pass from caresses to the most violent expression of rage. The females are rather more gentle than the males, and smaller, but when in troops are terribly quarrelsome with each other, particularly when they have young ones. These are tended with the greatest affection by the mothers, but the males inculcate pretty strict obedience by a good sound cuffing once in a while. Their teeth greatly resemble those of a human being, also their internal organization, and the fingers of their hands are free. Their walk is rather slow, but their usual gait is a trot or short gallop. They can stand erect with the greatest ease, but usually go on all fours. There is a great number of edible bulbs or ground nuts in the Cape, some good and very wholesome, but others poisonous. The senses of taste and smell in the chacmas are so keen that they readily reject the bad ones. When Le Vaillant was traveling in South Africa, he had a tame chacma with him, and when he found strange fruits on roots, his men would not touch them till they had been offered to the baboon. If he ate of them they were glad to do so too, and equally refused them when he did. Le Vaillant tells a curious story of how his chacma unearthed the roots it was so fond of. It seized the tuft of leaves with its teeth, dug about and loosened the root with its fingers, and then by drawing the head gently backward generally managed to extract it without breaking. When this course failed, he seized the tuft as before, as close to the root as possible, then suddenly throwing himself head over heels, the root rarely failed to follow. The cheek pouches are large, and when the animal found a good supply it was stowed in them for future use.

When I was at Simon's Bay, about twelve miles from Cape Town, I set off for a long tramp near the coast, but was warned to look out for baboons and keep out of their way. As I was going alone, I carried a double barreled gun, a pistol and a knife. Strange to say, unless attacked, baboons will avoid any one carrying a gun. On my way I fell in with a Scotch missionary, who was in charge of a small mission station in a very lonely part of the road. He was surprised to see me alone, and told me I might encounter danger from baboons or snakes. He and a Hottentot boy accompanied me for some distance and they told me numerous tales of the maraudings of the former.

Later on, I came to the house of an old pilot, and he showed me the wreck of his garden, that only a short time before had rejoiced his heart with the prospect of a fine harvest of pumpkins and melies. Half of them had been carried away, which was bad enough, but the greater part of the rest was destroyed. They will go any distance to a field of pumpkins, for the sake of the seeds, of which they are passionately fond. They tear them open to get at the seeds, and often one baboon will destroy a dozen in order to fill his pouches. A trap is sometimes set for them in the eastern districts, when their greediness brings their speedy destruction. A large pumpkin has a hole made in it just large enough for a hand to enter when open. Fresh shelled corn is mixed with the seeds, which is also a great temptation to the thief. A chacma comes along, and seeing a fine pumpkin and smelling the coveted bait, inserts his hand, which slips in easily. So he clutches a handful of seeds and corn, but it will not come out again. So reluctant is he to give up the favorite food that he will not relax his hold, but tries to escape with the pumpkin. This so embarrasses him and retards his flight that he falls an easy prey to the gun of the owner in ambush. Ordinarily the chacma would tear it to pieces, but loses his head under the, to him, strange conditions.

When going on their burglarious exploits, the chacmas display a great amount of intelligence and cunning. Arrived at the field of their operations, sentinels are posted on any eminence while the rest of the marauders collect their provision with the greatest expedition, filling their cheek pouches and tucking the green ears of corn under their arms. This is done silently, and at the slightest warning note, a low, peculiar cry of danger from the sentinels, away they rush yelling and screaming, very rarely being caught. Should any of their number come to grief, it is said that they drag away the unlucky sentinel who has failed in his duty to warn them of danger in time, and beat him to death. How true it may be, I know not, but it is so believed all over the colony.

Many people refuse to shoot them, for if not killed outright it is so terrible to see their death agonies. The wounded animal gives forth such mournful, pitiful cries, with so human a voice, as if asking for help, that few white people can be induced to shoot a second. Most of the quadrumani do the same. A little gray monkey I saw accidentally shot made so painful a scene before it died, its appealing looks, actions and cries were so exactly those of a badly hurt child, that I vowed never to shoot a monkey, and I never did, though I had several chances.

I had often heard that baboons can appreciate fire, though they cannot make it. A party had been picnicking in some woods, and in one part was a steep descent crossed by bold ledges of rock that made a series of steps down to a spring below. This place was fixed on as a capital one to dine in, and a large fire was lit on one of the ledges for cooking purposes. During the afternoon the party was broken up, and all dispersed, but considerable fire was left, as some of the logs used were very thick. Later it was discovered that one of the ladies had left her shawl or some other article on one of the ledges, and several of the gentlemen returned for it. On arriving at the spot they were startled to find the ledge where the fire was left, with a new set of occupants. A number of baboons had seated themselves near the fire, and some were engaged pushing the ends of the smaller sticks into it, while the others devoured the pieces of bread, rice and varied scraps left from the dinner. Luckily, the missing article had been dropped on the upper ledge, and the spectators did not linger long in such dangerous vicinity to these uninvited guests. Some farm hands who went there late in the evening found the baboons still chattering round the burning embers. Dogs are of very little use as guardians against these ferocious depredators. They pay no heed to them, unless the dog has the temerity to go for the chacma, when he gets handled so severely it is rarely he will attack a second time. Native guardians are little better, for the chacmas, with their patience and cunning in watching their opportunity, outwit the men, and gain their ends in the long run, in spite of them. The screechings and yellings they make when disturbed in their haunts are enough to frighten any one within hearing, and when you find great pieces of rock pelting down dangerously near your head, you are apt to take to your heels, happy if the screeching monsters do not overtake you.

During my residence in the East, I had a fine young chacma given me about three years old. He grew rapidly, and in about a year he was a large and dangerous animal to strangers, though very tame with me. He would sit beside me, playing like a child, but let any one come into the room, man or boy, and he raised himself fully erect, every hair on his head and neck standing out, made hideous faces and showed his powerful teeth, enough to intimidate any one, but a few gentle words from me calmed him. Fearing some accident, I had a large iron chain attached to a thick ring and placed round his body, and this was fastened by a strong bolt driven into a tree. Mr. Jean Louis, as he was called, took it all quietly, but on the first chance he got alone he broke a link in the chain with a stone in the same manner as a human being would do it, yet the links were as thick as the little finger of a man. On my return with a friend I found him up in a large bread fruit tree. The sight of a stranger so excited him he began pelting us with the heavy fruit, pretty dangerous missiles, when sent with so accurate an aim that we had to seek shelter to avoid them. My friend retreated precipitately, but when I was alone I soon had Jean Louis down under control. He was always accustomed to watch for my return, when at once he set to work with the impatience of a child to examine my pockets, as I always brought him a banana, guava or other fruit.

His curiosity was great, also his imitative faculties. Once he watched me attentively make a hole with a gimlet and insert a screw with a screwdriver, and he did the same fairly well. He could drive a nail as well as I could, draw a cork from a bottle and drink wine from a glass, and I believe I could have taught him almost anything save speech. I was the only male he would allow to approach him, but he never showed the same disposition to a female. His ferocious looks, however, were enough to deter any woman from going near him. It was my intention to bring him with me to America, but circumstances prevented it. A few days before I set sail, Jean Louis got loose and made for the cathedral and began tearing off the clapboards. Seeing the door open, he walked in and went to the pulpit, to the horror of the sexton who then caught sight of him. He seized and tore the velvet cushions, and when an attempt was made to dislodge him, he flung the Bible and prayer book at him and fairly drove him from the building. The police were called, and two men with loaded carbines shot my pet while standing erect defying them, but if I had been called I could have got him away quietly. When brought to the house and laid on the veranda he had almost a human look about him. Jean Louis now occupies a prominent place in the Museum of the Royal Society of Arts and Sciences at Port Louis, Mauritius.

The Keweenaw Copper Deposits.

A peninsula called Keweenaw Point, jutting into Lake Superior from the southern shore toward the northeast, is famous as the center of a vast copper mining industry. Last year the mines produced no less than 105,586,000 pounds of refined copper, and it is estimated that during next year production will be increased by at least 20 per cent. Mr. E. B. Hinsdale, who contributes to the latest bulletin of the American Geographical Society an article on the subject, has much that is interesting to say about the numerous prehistoric mines which have been found in this region. These ancient mines, judging from their extent, must have been worked for centuries. Who the workers were, no one can tell. They seem to have known nothing of the smelting of copper, for there are no traces of molten copper. What they sought were pieces that could be fashioned by cold hammering into useful articles and ornaments. They understood the use of fire in softening the rocks to enable them to break away the rock from the masses of copper. They could not drill, but used the stone hammer freely. More than ten cart loads of stone hammers were found in the neighborhood of the Minnesota mine. In one place the excavation was about 50 feet deep, and at the bottom were found timbers forming a scaffolding, and a large sheet of copper was discovered there. In another place, in one of the old pits, was found a mass of copper weighing 46 tons. At another point the excavation was 26 feet deep.

In another opening, at the depth of 18 feet, a mass of copper weighing over 6 tons was found, raised about 5 feet from its native bed by the ancients, and secured on oaken props. Every projecting point had been taken off, so that the exposed surface was smooth. Whoever the workers may have been, many centuries must have passed since their mines were abandoned. Their trenches and openings have been filled up, or nearly so. Monstrous trees have grown over their work and fallen to decay, other generations of trees springing up. When the mines were rediscovered, decayed trunks of large trees were lying over the works, while a heavy growth of live timber stood on the ground.

World's Fair Notes.

The great dome of the administration building, which will be the most conspicuous architectural feature of the exposition, and the four smaller domes, will be covered with aluminum bronze, a newly discovered amalgam, which is said to glisten brighter than gold. The contract for gilding the domes has been let for $54,000.

The party which, under the direction of Chief Putnam, of the Department of Ethnology, of the exposition, has been making excavations of the mounds in Ohio for three months or more, met with rare success on Nov. 14 near Chillicothe, in making one of the richest finds of the century in the way of prehistoric remains. While at work on a mound 500 feet long, 200 feet wide and 28 feet high, the excavators found near the center of the mound, at a depth of 14 feet, the massive skeleton of a man incased in copper armor. The head was covered by an oval-shaped copper cap; the jaws had copper mouldings; the arms were dressed in copper, while copper plates covered the chest and stomach, and on each side of the head, on protruding sticks, were wooden antlers ornamented with copper. The mouth was stuffed with genuine pearls of immense size, but much decayed. Around the neck was a necklace of bear's teeth, set with pearls. At the side of this skeleton was a female skeleton, the two being supposed to be those of man and wife. It is estimated that the bodies were buried fully 600 years ago. The excavators believe they have at last found the king of the mound builders.

THE ST. CLAIR TUNNEL DRAINAGE SYSTEM.

Our first page illustrations enable one to readily comprehend the amount of work that was deemed necessary for the purpose of keeping the great railway tunnel between the United States and Canada always free from water, and the manner in which the engineers met the difficulty. The area of sunken roadway included in the approaches, and the land on each side, for which drainage had to be provided, was fourteen acres on the Canada side and eleven and a half acres on the American side. The amount of rain which may fall in twenty-four or forty-eight hours at any given place, in localities where even the most complete records are kept, is always a variable quantity; but in a work of this kind, where absolute safety and the most thorough provision against any interruption of traffic are required, it was necessary to provide ample facilities for the immediate disposal of any quantity which might fall, and the engineers appear to have made their calculations on this basis.

On the Sarnia side two sizes of pumps are provided, the larger one, shown in our first page view, being a vertical, direct-acting, compound steam pumping engine, with a capacity of five million gallons in twenty-four hours. It is not expected that it will be necessary to employ this pump except during heavy and prolonged rains, a smaller duplex pump being located in the bottom of the shaft for ordinary use, and having a capacity of five hundred gallons per minute. All precipitation is led by stone drains at the base of the retaining walls, and from each side of the track, through a culvert crossing under the track, to a sump or well hole, from which the water passes, through a six-foot iron pipe, to the pumping shaft, 160 feet away. This shaft is made of cast iron rings bolted together in a manner similar to that followed in the construction of the tunnel, and is 15 feet 2 inches in diameter and 81 feet 3 inches in depth. It rests upon a timber base, upon which, within the shaft, is a six-foot masonry foundation for the large vertical and the small duplex pumps.

The vertical pumps are surmounted by large waterways or pipes reaching to the surface of the floor above, and through which pass the piston rods that connect with the steam cylinders resting upon the top of these waterways. Near the top is a discharge pipe 18 in. in diameter leading to a drainage connection with the St. Clair River.

As will be seen by the plan and sectional views on the first page, all of the water collected from the drainage area provided for is directed to and discharged from the pumping shaft, none of it being permitted to enter the tunnel. The compound engines employed have two high-pressure cylinders, 19¼ by 24 in., and two low-pressure cylinders of 33⅜ by 24 in., and the pump cylinder is 22 by 24 in. These are all located in a permanent house upon the bank of the approach, where also are four large steam boilers, two independent Ball dynamos that furnish the incandescent lights in the tunnel, and two large size Root exhausters that draw the foul air from the center of the tunnel, through two 20 inch sheet iron pipes, and one air and condensing pump for engines, capacity 20,000 cubic feet per minute.

The water that collects upon the American watershed is mostly directed in the same manner as upon the Sarnia side to a well near the tunnel entrance, where, in a masonry building on the south side of the tracks, are four duplex pumps, either or all of which may be called into use if necessary. Upon this side the banks are terraced, and part way down from the top of the bank a ditch is dug—extending U form from the beginning of the approach—the full length of the bank on each side and with a fall toward the tunnel. At the lower end of the U near the tunnel entrance a sewer connection gives sufficient fall for the water to flow to the river, thus lightening the work of the four-inch pumps. The capacity of the four pumps in this section is a total of 3,000 gallons per minute.

It will thus be seen that the drainage of both approaches is independent of the tunnel. The tunnel system is quite simple, and owing to the perfection of the tunnel work, but little water is required to be raised. We are informed by Mr. Hobson, the designer and builder of the entire tunnel, that with the exception of what little would be driven in to the ends of the tunnel by a slanting rain storm, there is not much more than the natural condensation upon the sides of the tunnel. Although this section covers a length of 6,026 feet, its drainage is provided for at the lowest slope of the tunnel by two pumps, as shown in the cut, one on either side of the tunnel, upon a bracket bolted to the rings, with the suction pipes curved against the side of the rings, and extending to the center of the track. These pumps are of the capacity of 500 gallons per minute. They are operated very ingeniously and without being at all objectionable in the tunnel. At the commencement of the work on the tunnel a trial shaft was sunk near the river bank, and this shaft now serves the purpose of receiving the steam pipe, exhaust pipe, and discharge pipe of the pumps and engines.

In making the plans for this great drainage work, the meteorologist of the Canadian government was consulted as to the records of the heaviest known rainfalls, and due consideration was given to all other available data. The average annual rainfall of the State of Michigan, and of all that section, has been for several years considerably below that of the sea coast in the vicinity of New York, but it is not the average rainfall so much as the sudden, heavy storms which require such extensive provision for the quick disposal of the water. The heaviest rainfall ever known in New York was in September, 1882, when the precipitation was just over six inches in depth during twenty-four hours, and during three days the fall was fifteen inches. Taking the rate for the day in which the fall was heaviest, a similar rain upon the fourteen acres for which this drainage system has been established at Sarnia would give only 2,280,936 gallons of water to be disposed of, which is not half the quantity whose removal is positively provided for at Sarnia in any twenty-four hours.

Oil Fires.

The *Engineering Magazine* for November contains a number of excellent articles. Among them is one by Edward Atkinson, in which some very practical and wholesome lessons are given relative to the construction of buildings for mechanical purposes. The following hints on oil fires are also given:

When oil or cotton waste takes fire in shops, one of the first impulses is to throw water upon it. The points brought out by Mr. Atkinson are of importance to all mechanics. He says that one of the largest losses which the insurance company of which he is president was ever called upon to pay was mainly caused by the misuse of a bucket of water. He describes the occurrence as follows:

"In the early evening a mechanic, who was working alone after mill hours near the main gears, dropped his lantern in the slush box, setting fire to the grease and lint collected therein. It burned with dense smoke and very little flame. Two or three shovels of sand or a wet blanket would have put it out. But he did what he supposed was the right thing—he threw a bucket of water upon the burning grease. Instantly a fierce flame sprang up to the very ceiling of the basement, passing through the belt holes, setting the mill on fire, which was completely destroyed. I was not then an officer of an insurance company, and I did not at that time take up the subject for investigation. A little later I happened to go to my seaside house with my boys in the early spring. I had not then invented the Aladdin oven, and we undertook to fry some fish on the top of the cooking stove; not being very skillful, we set the fat on fire. I took a dipper and poured some water into the burning fat. Straightway another great flash of flame roared up, singeing my hair and whiskers and reaching the ceiling of the kitchen. I then recalled the incidents of the mill fire, and determined to find out what it all meant."

Mr. Atkinson then consulted Prof. Ordway, of the Massachusetts Institute of Technology, who explained that steam combines with and takes up other gases, its own volume lifting or raising them, thus becoming a carrier of combustible vapor and flame to anything combustible situated over the fire. The best thing to extinguish burning fats or oils or oily waste is sand; and it would be a prudent thing to have buckets of this material standing in shops where flames of this character are liable to originate.

Printers' Roller Composition.

This composition, by Hawkins and Stacey, London, has an affinity for printers' ink, and is free from glycerine, which is a principal ingredient in roller compositions as usually made, but which repels the ink. A composition prepared according to the following formula has been found to answer well in practice: Glue or gelatine, 1 pound; water, 12 ounces; linseed or other suitable oil, 1 pound 8 ounces; treacle or sugar, from 1 pound to 1 pound 8 ounces; calcium chloride or potash, ⅜ ounce; powdered resin (if required), 2 ounces. The glue is first soaked in the water and then melted, and the linseed oil (warmed to a temperature of about 150° F.) is then very gradually added and thoroughly mixed with the melted glue. The sugar or treacle is then added to the mass kept at a suitable temperature, and the calcium chloride then incorporated. If a very tough composition be required, the resin (dissolved by heat in a little linseed oil) is to be added. The composition may be made non-absorbent of water by dispensing with the calcium chloride and substituting a similar amount of bismuth carbonate.

A Word to Mail Subscribers.

At the end of every year a great many subscriptions to the various SCIENTIFIC AMERICAN publications expire.

The bills for 1892 are now being mailed to those whose subscriptions come to an end with the year. Responding promptly to the invitation to renew saves removing the name from our subscription books, and secures without interruption the reception of the paper by the subscriber.

Correspondence.

Pure Coal in Oregon.

To the Editor of the Scientific American:

In your answer to inquiry in the SCIENTIFIC AMERICAN of November 7th regarding the finding of a supposed mineral wax at the mouth of the Nehalem River, Oregon, you state:

"The occurrence in quantity indicates the possibility of a . . . lignite bed in the neighborhood."

There are two distinct veins of pure coal found within three miles of the beach where the wax is found, 30 in. and 26 in. in thickness respectively. Both veins are of excellent quality for this coast. The analysis of the 26 in. vein is as follows:

Fixed carbon	54·7	per cent.
Combustible gases	35·1	"
Water	7·2	"
Ash	3·0	"
	100·00	

These may be of the lignite *age*, but hardly a lignite coal.

AUG. C. KINNEY.

Astoria, Oregon, November 20, 1891.

Ring Magnets.

To the Editor of the Scientific American:

In the early part of July, 1891, I separated the plates of a compound horse shoe magnet to remagnetize it, and, placing two of the plates on a board, with opposite poles touching, passed the poles of the other plates several times over them. The same process was used, alternately, with all the plates.

On the 13th of July it occurred to my mind that a study of the closed circuit of magnetism, when the two plates were lying on the table, with opposite poles touching, might open the way to some interesting discoveries. This led to an investigation of the old proposition, that a solid steel ring or circle cannot be magnetized in a circular direction. The usual proofs offered to establish this proposition are: (1st) That it has been tested by trial and found to be true, and (2d) that the proposition is self-evident, because there are no points, breaks, or openings for poles in a continuous or solid ring. Not satisfied with extant theories, the writer commenced a series of experiments in order to be able to demonstrate clearly and positively that the proposition is true, or to show, beyond question, that it is false. The result of these experiments fully establishes the counter proposition, and decisively proves that *a solid steel ring can be circularly magnetized.*

The first step was to have a flat steel bar, one-half inch wide, three-sixteenths thick, and twelve inches long, bent edgewise into a circle, and the two ends solidly welded. While hot and soft, it was sawn at two opposite points, on the flat side, more than half way through its thickness, that it might the more easily be cut into two semicircles, when cold, and after an attempt had been made to magnetize it. Then, when separated, if the two semicircular parts were not magnetic, the old proposition would be confirmed. If, on the contrary, any polarity, however feeble, could be observed, acting longitudinally, in the severed pieces, this would be irresistible evidence that the ring had been magnetized.

For obvious reasons, that ring has not yet been divided into two pieces. At each of the marked places, magnetism developed into a corresponding pair of poles, with power sufficient to take up and hold in suspension an eightpenny nail. This settles the question.

Instead of two, had several partial cuts been made in the ring, at each of them polarity would have appeared. The magnetic current passes through every atom of the metal, and only requires an opening to develop its presence. Further trials have revealed the peculiar fact that widening the cut within given limits, not indefinitely, increases the power. It has also been ascertained, by preparing a second ring, that one single cut develops more magnetism than each of two or more.

Pushing the investigation onward, as new paths for exploration came into view, another ring was prepared, similar to the first and second, except that it was not welded. The two ends were nicely dressed and brought into close contact, so as not only to touch but to press tightly together, by the elastic force of the steel. This ring, as were the others, was left untempered, except at the two ends, where it was made very hard. When magnetized, it possessed extraordinary attracting power, at the ends or poles. By a simple device they were made to separate or touch at pleasure. When the opening was from a sixteenth to an eighth of an inch wide, the magnet would lift more than three times its own weight. A ring magnet is certainly stronger than that of any other form, and yet I have never before known that shape to be used. If a number of such plates or rings were bolted together, they would make a surprisingly effective compound magnet.

THOS. HENDERSON.

Black Horse, Md., July 21, 1891.

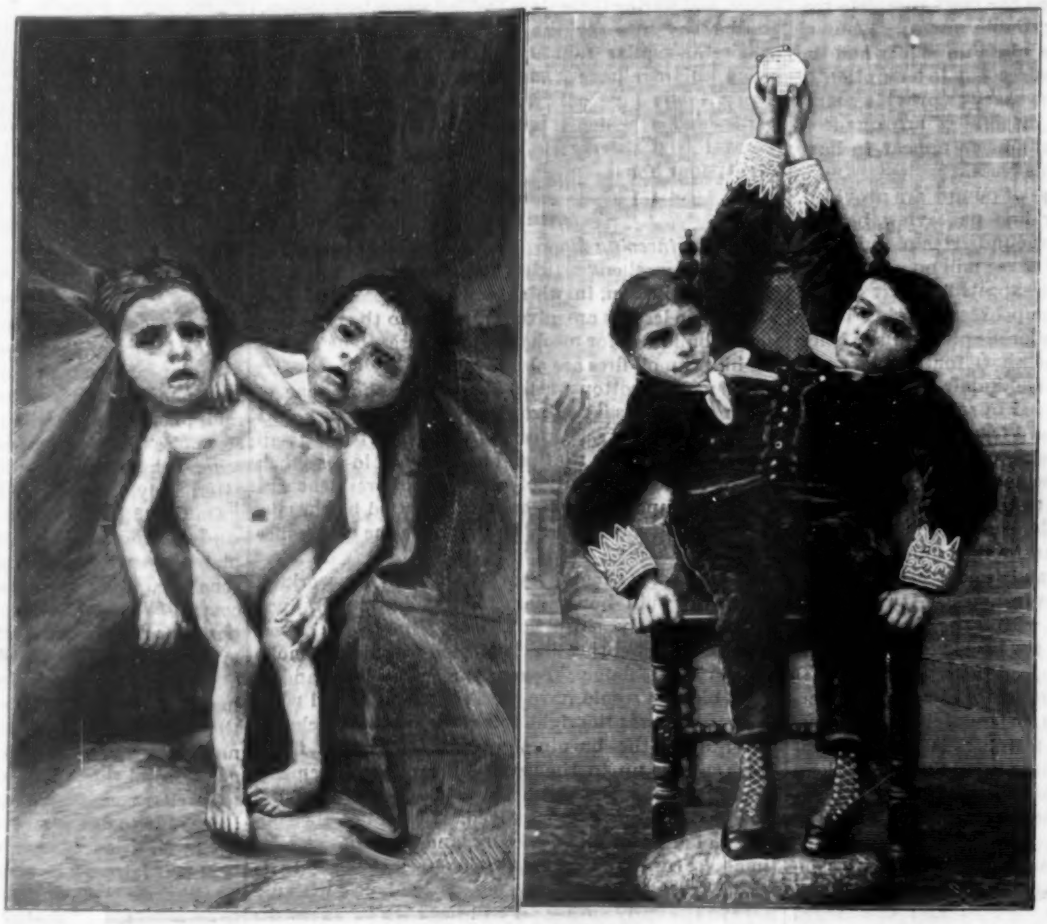
THE TOCCI TWINS.

We give illustrations of what are probably the most remarkable human twins that have ever approached maturity. They recently arrived in this country. They are known as the brothers Giovanni and Giacomo Tocci. They were born on July 4, 1875, their mother being nineteen years old. The mother's maiden name was Antonia Mezzano. Their birthplace was Locana, Turin (Italy). The same mother has had nine children, all strong and well. The twins are connected from the sixth rib downward, and have but one pair of legs and a single abdomen. The spinal columns are distinct until the lumbar region is reached. There they unite at an angle of 130 degrees. The sacrum seems to be a single bone. They have two distinct stomachs, hearts, and pairs of lungs. The arterial and respiratory systems are quite distinct; the heart beats and breathing differing often in the two individuals. At the age of thirty days they weighed eight pounds, and in the next thirty-one days gained nearly three pounds.

It was at this period of their lives that they were first subjected to critical examination.

Their lives are distinct. They have regions of common sensibility, and of purely individual sensation. One often sleeps when the other wakes. There is no direct correspondence of their appetites. One may be hungry while the other is fast asleep.

In their general appearance there is nothing repulsive. They have bright, intelligent faces, not of the peculiar cast common to cripples. They are educated and write their names as souvenirs for visitors.



THE TOCCI TWINS.

They are able to stand, but have not yet succeeded in walking, as each leg is governed by its own brain. The want of correspondence has proved fatal to any attempts in this direction. They can stand quietly, so that it is not only a question of strength. At their home they spend much of their time on the floor, using their inner arms for the most part, crawling and tumbling about and thus getting a certain amount of exercise. They can dress and undress themselves.

The one on the reader's left as he faces the picture, Giovanni, drinks beer in considerable quantities. The other one Giacomo, not liking beer, drinks mineral water in its place. Giovanni is quite fond of sketching and draws with some spirit. He rests the book or paper on his knee. Sometimes his brother, who is more of a talker and more volatile in disposition, finding some fault with the drawing, will kick the drawing off his knee. All this in good part, for they live on excellent terms with each other, and seem unconscious of any misfortune in their condition.

They are disconnected as regards illness. Quite recently one of them had a cold, while the other was suffering from a bilious attack.

The Siamese twins Eng and Chang, who died in 1874, within a few hours of each other, at the age of sixty years, were very celebrated. They were far less completely united. A thick fleshy ligament connected the lower ends of their breast bones. They were of a good degree of intelligence, conversed with visitors, and seemed reasonably well contented with their lot. Had the uniting ligament been purely muscular they could, doubtless, have been cut apart, with survival of both persons. The possibility of doing this was often discussed in their life. But on post mortem examination it was found that a process of peritoneum extended from one abdominal cavity to the other. But one or two cases are on record of the severing of such a ligament at the time of birth, with survival of even a single member of the pair. Before the Siamese twins, the "Hungarian sisters," Helena and Judith (1701-1723), obtained much celebrity. Their region of connection was the sacrum. The South Carolina negresses, Millie and Christine, exhibited under the misleading title of the two-headed nightingale, were another interesting example of twinning. They were also connected by the lower parts of the back, including the sacrum and probably lower lumbar region. They had four legs, and were really not much more closely connected than the Siamese twins. They enjoyed excellent health and spirits and used to sing together. They progressed by walking either on the rear pair of legs or on all four, in which case they moved sidewise. Waltzing was one of their accomplishments. Unquestionably their intestines were united. While they possessed common sensory nerve systems as regards the legs, both feeling a touch, the motor nerves were so distinct that one could not move the limbs of the other. They were born about 1851.

EXPERIMENTS IN PRESTIDIGITATION.

Spirit Slates.—Two ordinary wooden framed slates are presented to the spectators, and examined in succession by them. A small piece of chalk is introduced between the two slates, which are then united by a rubber band and held aloft in the prestidigitator's right hand.

Then, in the general silence, is heard the scratching of the chalk, which is writing between the two slates the answer to a question asked by one of the spectators—the name of a card thought of or the number of spots obtained by throwing two dice. The rubber band having been removed and the slates separated, one of them is seen to be covered with writing.

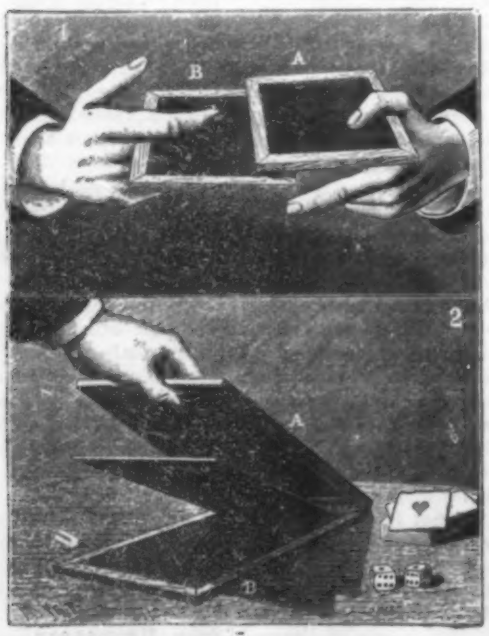
This prodigy, which at first sight seems to be so mysterious, is very easily realized.

The writing was done in advance; but upon the written side of the slate A there had been placed a thin sheet of black cardboard which hid the characters written with chalk. The two sides of this slate thus appeared absolutely clean.

The slate B is first given out for examination, and, after it has been returned to him, the operator says: "Do you want to examine the other one also?" And then, without any haste, he makes a pass analogous to that employed in shuffling cards. The slate A being held by the thumb and forefinger of the left hand and the slate B between the fore and middle finger of the right hand (Fig. 1), the two hands are brought together. But at the moment at which the slates are superposed, the thumb and forefinger of the right hand grasp the slate A, while at the same time the fore and middle finger of the left hand take the slate B. Then the two hands separate anew, and the slate that has already been examined, instead of the second one, is put into the hands of the spectator. This shifting, done with deliberation, is entirely invisible.

During the second examination the slate A is laid flat upon a table, the written face turned upward and covered with black cardboard. The slate having been sufficiently examined, and been returned to the operator, the latter lays it upon the first, and both are then surrounded by the rubber band.

It is then that the operator holds up the slates with the left hand, of which one sees but the thumb, while upon the posterior face of the second slate the nail of his middle finger makes a sound, resembling that produced by chalk when written with. When the operator judges that this little comedy has lasted quite long enough, he lays the two slates horizontally upon his table, taking care, this time, that the non-prepared slate shall be beneath (Fig. 2). It is upon it that then rests the black cardboard, and the other slate, on be-



Figs. 1 and 2.—SPIRIT SLATES.

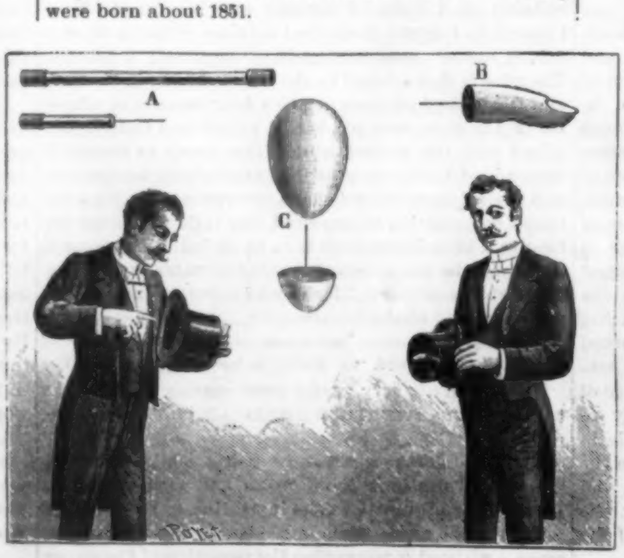


Fig. 3.—PASSING A FINGER, ROD, AND EGG THROUGH A HAT.

Fig. 4.—THE ENDLESS PAPER RIBBON.

ing raised, shows the characters that it bears, and that are stated to have been written by an invisible spirit that slipped in between the two slates.

Our readers will not ask us how we manage to know in advance what should be written upon the slate. It is useless to say that deceit is allowable in prestidigitation; loaded dice always turn up the same number, and nothing is easier than to know the name of the card that a spectator will draw from a pack composed of thirty-two similar cards, if one is not skillful enough to cause him to take the forced card.

Tricks with a Hat.—Prestidigitators frequently borrow from their spectators a hat that serves them for the performance of very neat tricks which are not always easily explained. We shall describe some of the most interesting of these.

The operator will begin by proving to you that the felt of your hat is of bad quality, and, to this effect, he will pierce it here and there, with his finger, his magic wand, an egg, and with a host of other objects.

This is all an illusion, the mystery of which is explained by Fig. 3. See the finger B. It is either of wood or cardboard, and terminates in a long slender needle. The prestidigitator, who has concealed the finger in his left hand, thrusts the point into the top of the hat, whose interior is turned toward the spectators. Afterward, raising the right hand, the forefinger of which he points forward, he seems to be about to pierce the top of the hat, but, instead of finishing the motion began, he quickly seizes in the interior, between the thumb and forefinger, the point of the needle, wiggles it around in all directions, turns the hat over, and the cardboard finger, which moves, seems to be the prestidigitator's own finger. The same operation is performed with the wooden half egg, C and the rod A, which, like the finger, appear to traverse the hat, in the interior of which are hidden the true rod and egg. We may likewise solder a needle to a half of a five franc piece, and thus vary the objects employed for this recreation to infinity.

In order to take from a hat a large quantity of paper in ribbons, and then doves, and even a duck or a rabbit, there is no need of special apparatus nor of a great amount of dexterity, and still less of the revolving bobbin or of the mysterious machine whose existence is generally believed in by the spectators when they see the paper falling regularly from the hat, and turning gracefully of itself as the water from a new sort of fountain would do.

Nor is there here any need of a high hat; a simple straw hat (or a cap, at a pinch) will suffice. The prestidigitator holds close pressed to his breast and hidden under his coat a roll of the blue paper prepared for the printing apparatus of the Morse telegraph, and which is so tightly wound that it has the aspect and consistence of a wooden disk with a circular aperture in the center. In turning around after taking the hat, the opening of which rests against his breast, the operator deftly introduces into it the roll of paper, which has the proper diameter to allow it to enter by hard friction as far as to the top of the hat, and stay where it is put even when the hat is turned over.

Were it needed, the paper might be held by a proper pressure of the left hand exerted from the exterior. The introduction of the paper is effected in a fraction of a second.

"Your hat, my dear sir, was doubtless a little too wide for your head, for I notice within it a band of paper designed to diminish the internal diameter," says the prestidigitator, while, at the same time, he draws from the hat the end that terminates the paper in the center of the roll. Then he reverses the hat so that the interior cannot be seen by the spectators. The paper immediately begins to unwind of itself and to fall very regularly and without intermission (Fig. 4, to the right).

When the fall of the paper begins to slacken, that is, in general, when no more than a third of the roll remains, the prestidigitator turns the hat upside down, and, with the right hand, pulls out and rapidly revolves in the air the paper ribbon, whose capricious contours, succeeding one another before the first have had time to fall to the floor, produce a very pretty effect (Fig. 4). The quantity of paper extracted from the hat appears also in this way much greater than it really is, and at length forms a pile of considerable bulk.

This experiment may be completed in the following manner: The operator, approaching his table, which, upon a board suspended behind it, carries a firmly bound pigeon, quickly seizes the poor animal in passing, and conceals it under the pile of paper, while he puts the latter back into the hat, in order to see, says he, whether all that has been taken out can be made to enter anew.

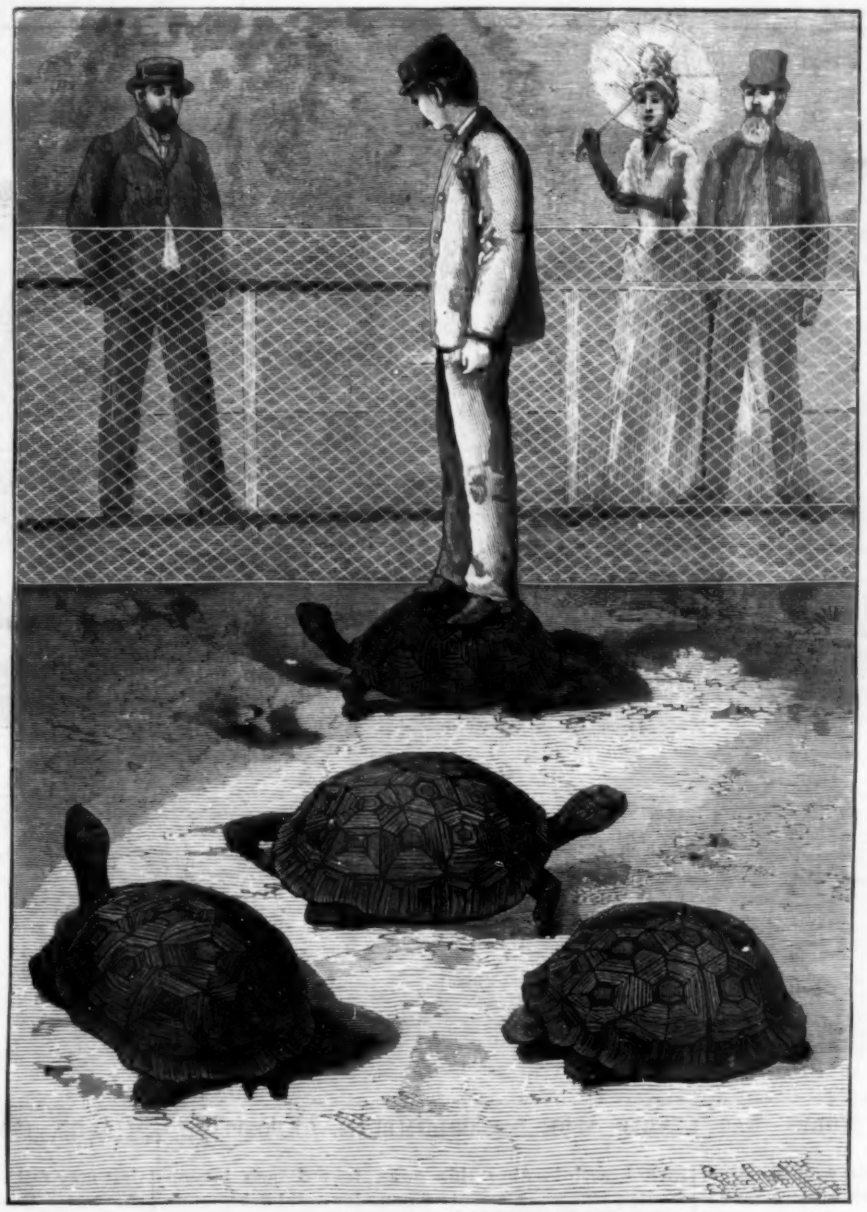
Having thus introduced the pigeon or any other object into the hat, the paper is taken out, and it is at the moment that the hat is restored to its owner that he pretends to discover that it still contains something. —*La Nature.*

THE GALAPAGAS TORTOISES.

If the visitor to the Central Park menagerie will pass into the house behind the lion quarters, and walking past the stalls where the graceful antelopes of South Africa, the pretty gemsbok (*Oryx gazella*), are confined, look over the last bin on the right hand side, he will see a group of interesting objects—the Galapagas tortoises. If the temperature, the character of the day, and their own dispositions are in accord, he will find them taking some interest in their surroundings, and may be able to observe their stiff and strained attitudes, their inane, staring eyes, their gaunt, wrinkled necks, and the comical protrusion of their legs. But if it is dark, or the surfeit of a late dinner has thrown them into post-prandial reflections, he will observe nothing but a bundle of dirty brown box-like humps, which are marked on their outer surface by a series of sculptured and raised ridges, while dimly seen within the gaping edges of their front and back margins, the folded limbs and withdrawn somnolent heads of their inmates are provokingly descried, motionless and torpid. These lumps of bone have, however, to the naturalist a great interest. They have been brought from that remarkable group of islands which lie some seven hundred miles from the west coast of South America, opposite Ecuador, beneath the equator, and belong to a fauna which, from its remote and insular position, has assumed an indigenous and unique character. Indeed, the Galapagas Islands have received their name from these large tortoises. The name Galapagas alludes to them, which is seen more clearly in the German translation, *Schildkroteninseln*, and in the French, *Isles des Tortues*, both designations being literally the islands of the tortoises. Chas. Darwin has devoted a chapter in his "Voyage of the Beagle" to a description of these curious reptiles, and they have been made the subject of many sketches by the chance tourists or wandering visitors of this remote region. Dr. A. Gunther also prepared a masterly paper on these animals for the *Philosophical Transactions*, of England, and their discussion is a wide and tempting field in the subject of animal distribution and variation.

The Galapagas Islands are volcanic in their origin and present desolate surfaces of scoriæ, rugged and black surfaces of blistered and splintered lava. Here these immense tortoises were found by some of the earliest navigators, and were long resorted to as food by the buccaneers of the Spanish Main. Their flesh, especially that upon the breast bone, as instanced by Darwin, is very delicious, and as they retain their size and sweetness after months of confinement, they afforded a very convenient source of food for the provisioning of ships which would be for a long time away from means of supply of fresh meat. The great numbers of these reptiles in the islands before they had become reduced by men were surprising. They had multiplied in unchecked fecundity, and this, combined with their length of life, resulted in an enormous population. In 1680 Dampier said of them: "The land turtle are here so numerous that five or six hundred men might subsist on them alone for several months without any other sort of provision." As early as Admiral Porter's visit to these islands (1813) the difference between the occupants of the different islands had been noticed. Dr. Gunther has separated the tortoises from this group into five different species, each restricted to its own island, and assumes their derivation from some typical ancestor whose characters have gradually diverged into these subordinate races by reason of the varying features of food and habits. Darwin has given some of the most interesting observations about these strange creatures. They live by preference on the higher and more moist portions of the islands, though found in the arid and lower coast country. They are forced to travel considerable distances toward the center of the islands to secure water, and in this connection Darwin makes one of the most suggestive and entertaining statements in his account of his visit to the Galapagas Islands.

He says ("Voyage of the Beagle"), "The tortoise is very fond of water, drinking large quantities, and wallowing in the mud. The larger islands alone possess springs, and these are always situated toward the central parts and at a considerable height. The tortoises, therefore, which frequent the lower districts, when thirsty are obliged to travel from a long distance. Hence broad and well beaten paths branch off in every direction from the wells down to the seacoast, and the Spaniards, by following them up, first discovered the watering places. When I landed at Chatham Island, I could not imagine what animal traveled so methodically along well chosen tracks. Near the springs it was a curious spectacle to behold many of these huge creatures, one set traveling onward with outstretched necks, and another set returning, after having drunk their fill. When the tortoise arrives at the spring, quite regardless of any spectator he buries his head in the water above his eyes, and greedily swallows great mouthfuls, at the rate of about ten in a minute. The inhabitants say each animal stays three or four days in the neighborhood of the water, and then returns to the lower country; but they differed respecting the frequency of these visits. The animal probably regulates them according to the nature of the food on which it has lived. It is, however, certain that tortoises can subsist even on those islands where there is no other water than what falls during a few rainy days in the year." A most surprising peculiarity of this creature is the retention of water in its urinary bladder which subserves the purposes of the animal, and can even be imbibed by men, Darwin asserting that when the bladder is full, the liquid is quite limpid and only



THE GALAPAGAS TORTOISES.

slightly bitter. The Galapagas tortoise appears to be quite deaf, and gives but few audible indications of life. These are limited to the deep hiss it emits when disturbed, as it withdraws its head within its hard integument, and the roar given by the male in the breeding season. The female deposits its eggs in the sand and covers them up, but in rocky places drops them "indiscriminately in any hole." The eggs are white and spherical and are found 7 inches in circumference.

The young become the prey of the flesh-eating buzzards, while those who escape and reach maturity die from accidents, as a natural death from disease or age seems almost unknown. They can be handled with impunity, but from their enormous size they frequently require the united efforts of five or seven men to lift them. They feed upon cactus or the leaves of various trees. They appear to be aboriginal inhabitants of these islands, and, therefore, have an almost exciting interest to naturalists; but they are also representatives of a wider distribution, for allied forms and even fossil remains of congeric species are found in Mauritius and its neighboring islands. They may be remnants of a tribe which over a broad Pacific continent has had an extreme easterly and westerly dispersion, and now separated from their western allies have, in conjunction with these latter, undergone varietal changes which have become inherited, and established separate generic groups. L. P. G.

MODEL BATTLESHIP AT THE WORLD'S COLUMBIAN EXPOSITION.

A model man-of-war is to be exhibited by the United States government. This, to all appearance, will be a faithful full-sized model of one of the new coast line battleships designed by the Bureau of Construction and Repair of the Navy Department, and now being built at a cost of about $3,000,000 each, by Cramp & Son, Philadelphia, and the Union Ironworks, San Francisco. This imitation battleship of 1893 will be erected on piling on the lake front in the northeast corner of Jackson Park, at the pier which forms the prolongation of Fifty-ninth Street. It will thus be surrounded by water, and will have the appearance of being moored to a wharf. The structure is to have all the fittings that belong to the actual ship, such as guns, turrets, torpedo tubes, torpedo nets and booms with boats, anchors, chain cables, davits, awnings, deck fittings, etc., together with all the appliances for working the same. Officers, seamen, mechanics, and marines will be detailed by the Navy Department during the Exposition, and the discipline and mode of life on board naval vessels will be completely shown. The detail of men will not, however, be so great as the complement of the actual ship, the object being mainly to have expert janitors and showmen for the valuable public property. It is expected, however, to give certain drills—especially boat, torpedo, and gun drills—as in a vessel of war.

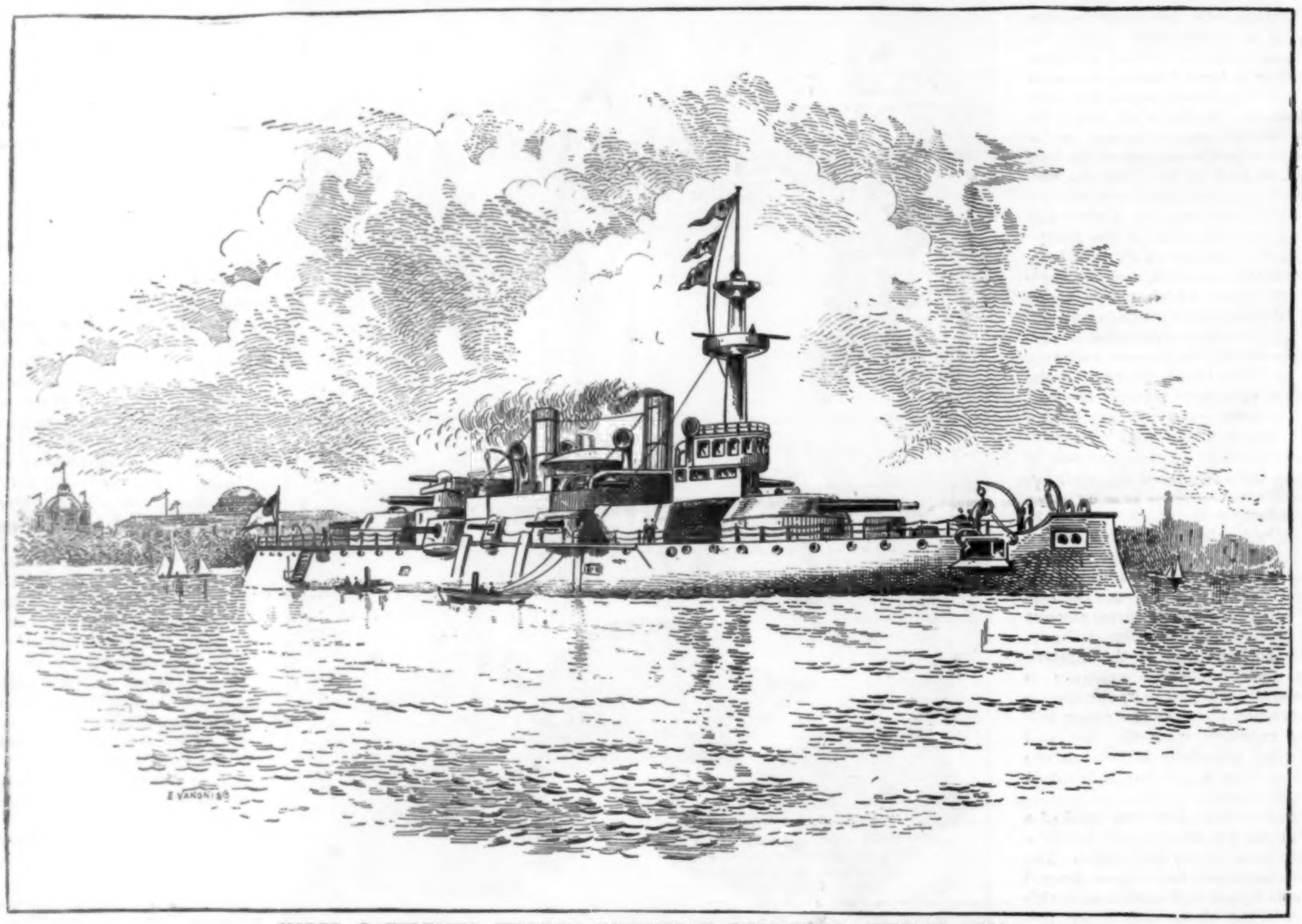
The structure will, therefore, serve the double purpose of housing the naval exhibit and illustrating the manner in which the men of the United States navy live. The dimensions of the structure will be those of the actual battleship, to wit: Length, 348 feet, and width amidships, 69 feet 3 inches. From the water line to the top of the main deck, 12 feet, on top and in the central position of which is a superstructure 8 feet high, with a hammock berthing resting on the same, 7 feet high, and above these will be the bridge, chart house, and the boats. At the forward end of the superstructure there will be a cone-shaped tower, called the military mast, near the top of which will be placed two circular tops as receptacles for sharpshooters, and rapid-firing guns will be mounted in each of these tops. The height from the water line to the summit of this military mast will be 76 feet, and above it will be placed a flag staff for signaling; the staff will be 24 feet long. The battery, mounted, will be four 13 inch breech-loading rifle guns, eight 8 inch breech-loading rifle guns, four 6 inch breech-loading rifle guns, twenty 6-pounder rapid-firing guns, six 1-pounder rapid-firing guns, two Gatling guns, and six torpedo tubes or torpedo guns.

The 13 inch guns are to be placed at each end of the superstructure, six feet above the main deck, mounted in pairs within a circular turret that revolves within redoubts 36 feet 7 inches in diameter; the redoubts extend below through the main deck, and rest on the berth deck. The 8 inch guns rest upon the superstructure deck, and are also mounted in pairs within turrets and redoubts, from which large circular ammunition tubes pass down to the berth deck. The 6 inch guns are on the main deck, within the superstructure, and have ports cut through the sides of the same, with automatic shutters. The 6-pounders are placed along the sides, on top of the bridge and hammock berthings. The 1-pounders are on the forward and after ends of the berth deck, and in the "lower top" of the military mast. The Gatling guns are in the "upper top" of the mast, and the torpedo tubes are on the berth deck—two on each side amidships and one at each end of the vessel, with ports cut through the sides and ends for the torpedoes.

The structure will, as stated before, rest on piles as a foundation. The berth deck will be composed of thick plank laid upon the foundation, on top of which there is to be a substantial layer of brick concrete. The sides of the hull are to be of brick, stepped to give contour, over which there will be a filling of concrete, thickly coated with cement. The ends are to be shaped with iron plates. On the inside of the walls, and over the concrete on the berth deck, there will be a coating of cement, thus making the structure fireproof and free from moisture. Along the top and bottom, and taking the shape of the superstructure, are heavy angle irons, to which vertical T-irons are fastened, spaced about 4 feet apart, and braced diagonally. The walls, outside and inside, are to have a thick coat of cement on metal lathing, well secured to the vertical framing. The main and superstructure decks will have a rise of 6 inches in 69 feet. The deck plank will be yellow pine 6 inches wide and 2 inches thick, the seams of which will be caulked. The main deck beams will be steel, T-bulb pattern, 7 feet by 5 feet, and 26 pounds per foot, the ends turned down and fastened to bearing plates on brick piers in the sides of the hull. The superstructure deck beams will be steel, T-bulb, 7 pounds by 5 pounds and 10 pounds per foot, the ends fastened to the top angles at the sides of the superstructure. Iron tube pillars are to be used further to support the beams. Gutters of galvanized iron are carried around the waterways, rolling over and forming a bead finished on the outside, from which numerous conductors carry the water that may fall on the deck down the scuppers close to the water line. The turrets and redoubts for the 8 inch and 13 inch guns are to be made up of cement on metal lathing fastened to a wood framing, and are to have all the appliances for operating them. A 13 inch gun is 44 feet long, and weighs with its carriage 115½ tons. The transportation and placing of so much weight upon a structure such as is described being impracticable, the difficulty of showing what the real battleship carries has been overcome by building the gun of cement over a wooden tube, to be rifled, and fitted with a breech plug complete, the finish of the cement being such as to give it the appearance of an actual gun.

The military mast and conning tower are to be framed with gas tubing, to which will be secured a metal lathing, with a coat of cement on the outside. The tops of the military masts are to be made of iron, securely fastened to the framing of the mast. The exterior of the entire structure will be tinted in accordance with the navy regulations, so as to give it the exact appearance of a vessel of war.

Beneath the berth deck, and directly below the turrets of the 13 inch guns, are to be the magazines, showing the stowage, lighting, and flooding, according to the navy regulations. The superstructure will show the cabins, state rooms, lavatories, mess rooms, galley and fittings, mess table for crew, lockers, berthings, etc., also the methods in which officers and enlisted men live, according to the rules of the navy.



MODEL BATTLESHIP, WORLD'S COLUMBIAN EXPOSITION, CHICAGO, 1893.

RECENTLY PATENTED INVENTIONS.

Agricultural.

POTATO DIGGER. — John W. Cook, Jefferson, Oregon. This is designed to be a simple, easily worked and inexpensive machine, in which the revolving hoe or digger is formed of a series of radial scoops having cutting and lifting blades at their outer ends and screening portions to the rear of the blades. The digger is connected to the main axle to be revolved in a direction opposite to the movement of the machine, to scoop forward and lift the dirt and potatoes up over the digger axle, sifting out the dirt and discharging the potatoes to the rear.

CULTIVATOR ATTACHMENT. — Charles A. Armstrong, Pawnee Rock, Kansas. This is an improvement in removable fenders for the protection of young plants while being cultivated, being designed to prevent dirt from being thrown upon them by the cultivator plows or teeth. The cover device or protector consists of two adjustable sections, arms projected from one end of the device and beams pivoted to the arms, while removable clamps connect the beams with the axle of the cultivator, and there is a connection between the device and the gangs of the cultivator. With this device the plows may be safely set much closer to the rows than heretofore, and the amount of earth delivered by the plows to the plants may be regulated as desired.

CORN PLANTER. — John B. Adams, Jr., Malden, N. Y. Corn may be planted in hills by this device, and fertilizer be also deposited in the hills previous to dropping the corn, the mechanism regulating the supply of fertilizer and seed acting together. Means are also provided whereby the fertilizer will be partially covered before the seed is dropped in the hill, the seed being also covered and the ground pressed down upon it. A simple and effective check attachment is connected with the implement, whereby it may be converted into a check row planter, and it may be used with a single set of boxes and drawn by a single horse, or as a double machine, drawn by a team, and operating on two hills at once.

CORN CUTTING MACHINE. — Harry Willits, New Boston, Ill. This invention relates to a former patented invention of the same inventor for a device for slicing corn ears into pieces, and provides additional features to increase the cutting capacity and general efficiency of the machine. An improved feed throat and cutting device is provided, and a novel gauge to regulate the length of corn ear subdivisions. The cutter shaft of the machine is rotated by working a treadle, the operator using both hands to thrust corn ears, piled on the table, down through the throats, and the pieces sliding through a chute away from the cutter.

Mechanical Appliances.

MINERS' AND BLASTERS' TOOL. — Richard A. McVitty, Snohomish, Washington. This is a combination tool comprising all of the implements necessary for use in the treatment of fuses or for the attachment of caps to fuses, or for inserting the capped fuse in a cartridge. It consists of two pivoted spring actuated members having cutters of different shapes and sizes adjacent to their pivoted points, with recesses in the inner faces of their head sections, one of the recesses being provided with a removable blade, while a link is adapted to close the handle sections of the members and serve as a suspension device. The tool is designed to be very simple and durable, occupying but a small space, and capable of being quickly and easily manipulated.

ROLL FOR CUTTING METAL BLANKS. —Cyrus A. Peterson, Stratton, Neb. This is a shearing roll for cutting blanks for fence posts for wire or board fences, and consists of a pair of metal rolls having indented casts or cuts therein, the pattern for the blanks covering the entire periphery of the rolls, and the patterns on the two rolls forming the cutting or shearing edges, which operate to subdivide the whole of the metal sheet into blanks with as little waste as possible. At the ends of the blank patterns are short cutting edges on the rolls to sever the blank strips into individual blanks. The sheet metal is preferably run through the rollers hot, and in the same heat used in rolling the sheet, to avoid the expense of reheating.

WIRE FEEDING DEVICE. — Joseph S. Blackburn, Salem, Ohio. This is a feed more especially designed for use on nailing machines, and is designed to be simple and durable in construction and very effective in operation. The improvement is mounted on a plate, to which two vertical parallel levers are pivoted at one end, the other ends of the levers being pivoted to two horizontal parallel movable jaws, a spring acting against the levers, while a plate serving to holding the wire in place is pivoted to and connects the jaws.

Miscellaneous.

CLOTHES LINE SUPPORT.—Robert McNab, Paterson, N. J. Combined with a horizontally swinging support secured to the outside of a window frame, is a main arm journaled on the support and having teeth on one side, a pulley head provided with a pawl sliding on the arm. The device is adapted to hold one end of a line when the opposite end is held on suitable outdoor supports, and is designed to be quickly adjusted to a desired position, so that the arm carrying the main line roller may be made to align with any outdoor support, while the device automatically adjusts itself to any decrease in the length of the line.

CLOTHES PIN. — Theodore Garrison, Hazleton, Pa. This device consists of a single piece of wire formed into a nearly rectangular frame having clamping tongues integral with and bearing upon it, and coiled spring suspending eyes, the device being normally attached to the line, and clasping and holding the clothes, which are not clamped directly to the line.

CLOTHES DRIER. — John McKinnon, Moscow, Idaho. A reel is supported upon a post in such manner that a number of lines may be attached to the reel arms, and the lines be readily brought within easy reach to attach the clothes thereto. The drier will carry a large quantity of clothes in proportion to its size, and when the reel is brought to a horizontal position it turns easily, so that the clothes will be freely exposed to the wind and sun to facilitate their drying rapidly.

ADJUSTABLE POLE.—Stephen A. Bartlett, South Amboy, N. J. This invention provides an improved construction of poles for use as measuring rods, clothes poles, etc., a sliding connection being provided for the members whereby the pole may be lengthened or shortened as desired. An anti-friction roller is mounted in one of the guides and a cam lever in the other guide, to clamp the members together, the cam bearing against a movable wear plate, while a rubber block is pivoted to the inner face of one member to contact with the opposite member under the pressure of the cam lever.

COFFIN LID AND HINGE.—William J. Collinson, Hazleton, Pa. This invention provides a lid and hinge enabling the lid to be easily raised or pushed to one side, to lie flatwise on the coffin, the peculiar formation of the hinge serving to hold the lid in place as well as to operate as an ordinary hinge. The improvement is also adapted for use on any kind of a receptacle.

CAR WHEEL CHILL. — Ferdinand E. Canda, New York City. This is an improvement on a former patented invention of the same inventor, by means of which the chill is so constructed that each segment of the chilling face will be supported at two points instead of one, preventing it from warping or twisting out of shape, so that the periphery of a wheel formed on the chill will be truly circular. The chill consists of a support formed of three or more parallel rings, two series of webs projecting inwardly from the rings toward the center of the chill, the webs of one series alternating with those of the other series, one series of webs being supported by one outer ring and an inner ring, and the other series of webs being supported by the other outer ring and an inner ring, while chilling faces are formed on the inner ends of the webs, the chilling faces, the webs, and the rings being formed integrally in a single casting.

TABLE LEAF SUPPORT. — Charles K. Olson, Red Wing, Minn. Combined with a curved and pivoted brace having a transverse recess in its outer end is a bracket having a longitudinal slot to receive the brace, while a bodily movable locking key having headed ends fits loosely in the transverse slot of the bracket above the brace, with other novel features, the improvement being very simple in construction, and forming a support for the drop leaves of tables which is very easy of adjustment and holds the table leaf in such a manner that it cannot possibly become loose by accident, while it may be easily released so that the leaf will drop when necessary.

MUSIC LEAF TURNER. — Evander B. Newcomb, Parsons, Kansas. This is a simple, durable and ornamental device, which may be readily attached to or detached from the music rack of an instrument, to facilitate turning over the leaves of the music. Combined with arms adapted for engagement with the leaves, and capable of lateral movement, is an actuating mechanism having connected finger blocks, the latter being adjustable to and from the mechanism.

SAFETY ENVELOPE. — James Malone, Louisville, Ky. This invention relates to envelopes used for holding money, bonds, or other valuables, providing an envelope which, when sealed and folded, cannot be opened by steaming, while the contents cannot be reached by instruments inserted through the joints or seams without obvious mutilation. The blank is of novel form, and is designed to be so folded that all the edges of the envelope are of double thickness and all the corners of quadruple thickness, thereby making a strong and durable as well as a safe envelope.

ARTIFICIAL FRUIT. — Caroline Hyde, Stonington, Conn. The skin portion of the fruit to be made, according to this invention, consists of silk or other suitable fabric, which will admit of being painted to represent the fruit, and a straight piece is puckered or ruffled along two edges, the ruffles on each edge being united by a thread. One of these threads is then drawn to close one ruffled edge, and the ends of the cloth are united to form a bag, into which any suitable absorbent and penetrable, preferably flocculent, material, is inserted as a filling, a wire thread or cord being run up through the filling, and virtually forming the stem of the fruit.

INVALID BEDSTEAD.—William Coughlin, New York City. The bottom of this bedstead is made in two sections, of which one is fixed and the other is hinged to the rails of the bedstead, to permit of conveniently placing a patient in an inclined position without touching him. The mattress and other parts of the bed resting on the fixed and movable parts of the bottom are sufficiently flexible to readily adapt themselves to different positions of the movable part.

THERAPEUTIC ELECTRIC BATTERY.—John A. Crisp, Jefferson, Ohio. This is a simple battery which may be readily carried in the pocket or on the body and quickly adjusted to give the desired current. It consists of a series of cells of copper and zinc plates with an interposed absorbent material, the copper plates having projecting ears and the zinc plate of one of the cells a socket, the ears projecting through a waterproof pocket which receives the battery, while conducting wires have fingers which engage the socket and one of the ears.

VAPOR BATH APPLIANCE. — Clark Cady, Waldron, Mich. This is a rapid steam generator adapted for use with an ordinary cooking stove, and connected by tubing with a closed box in which a vapor bath may be taken. The device is under the control of the operator, who can regulate the generating of the steam to suit himself, and provision is made for cooling the steam if desired before passing it to the bathing apparatus.

WASHING MACHINE. — Randison Newell, Kenton, Tenn. This invention relates more particularly to an improved machine which combines features of those classes of machines known as "roller and bed" and "reciprocating rubber" machines. The invention is designed to provide a machine of cheap and simple construction, easy and convenient to operate, and thoroughly efficient in cleansing the clothes rapidly without injuring them. The construction is such that each article is cleansed in a separate water.

MEASURING TANK. — Charles W. Proctor, Lake Forest, Ill. This device consists of a revoluble tank, to an inner wall of which is secured a basin with which is connected a gauge glass, and from which leads an outlet pipe. The tank is especially adapted for holding oil and similar liquids in such a manner that the contents cannot be easily spilled, while the liquid may be quickly and accurately measured, so that any desired quantity may be drawn from the tank.

HORSE CLEANER. — William W. Cole, Eudora, Kansas. This is an implement to be used in place of the usual curry comb. It consists of a frame carrying wires under adjustable tension and provided with a suitable handle by means of which the implement may be applied to a horse. In doing this the handle is grasped by both hands, and the wires rubbed along the skin in one or both directions.

FIGURE TOY. — George Y. S. Wada, San Francisco, Cal. This toy is so constructed that two jointed figures, representing prize fighters, may be caused, by the working of certain levers, to make the movements of actual prize fighters engaged in a contest with one another. Means are also provided whereby one of the men represented as fighting may be forced suddenly downward, as though he had been knocked down by a blow from his opponent.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention and date of this paper.

SCIENTIFIC AMERICAN

BUILDING EDITION.

DECEMBER NUMBER.—(No. 74.)

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1. Handsome plate in colors of a cottage erected on Great Diamond Island, near Portland, Maine, at a cost of $800 complete. Floor plans and perspective elevation.
2. Plate in colors of a beautiful residence at Chester Hill, Mount Vernon, N. Y., also a second view in perspective, with floor plans, etc. Cost $8,500.
3. A comfortable cottage to cost $3,000. Plans and perspective.
4. Design of an ornamental oriel or bay window from a dwelling at Paris.
5. A colonial house erected on Chester Hill, Mount Vernon, N. Y., at a cost of $8,900 complete. Floor plans and perspective elevation.
6. Dwelling at Montclair, N. J. Cost $3,500 complete. Floor plans and perspective.
7. An attractive cottage at Portchester, N. Y., estimated cost $4,200. Perspective and plans.
8. Handsome residence at Bensonhurst, Long Island, erected at a cost of $7,000 complete. Perspective elevation and floor plans.
9. Sketch of a small cottage or lodge.
10. Block of seven dwellings recently erected at Brookline, Mass., at a cost of $150,000 for the entire block. Messrs. Fehmer & Page, architects, Boston, Mass. Floor plans and perspective.
11. A handsome house for $7,500 erected at Montclair, N. J. The design is a unique model of coziness. Floor plans and perspective.
12. Triumphal arch, Timegad, Algeria, from a drawing by Mr. Alexander Graham, F.S.A.
13. Restoration of triumphal arch, Timegad, Algeria, from a drawing by Mr. Alexander Graham, F. S.A.
14. A modern dwelling of attractive design erected on Grand Avenue, at Asbury Park, N. J. Cost $4,500 complete. Floor plans and perspective elevation.
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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
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Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(3706) M. S. says: I am running a saw mill and am greatly troubled by my mill roof catching fire from sparks. Can you tell me if there is any paint or composition that will render it fireproof (against sparks), and if so, how to make it, and how to apply it? A. A wash for your roof that is fairly fireproof may be made of Portland cement, borax, and sal ammoniac. In each pail of water dissolve ¼ pound borax and ⅜ pound of sal ammoniac. Then add cement enough to make the water creamy, so that it will spread with a whitewash brush. Slush the roof with the wash, so that every crevice where sparks may lodge may have a coating of the cement.

(3707) M. B. asks: What is the difference in the power required to move a load mounted on wheels 4 feet in diameter, and the same load on wheels 2 feet in diameter? Which will move the easier, and why, on iron rails? A. The larger wheels will move slightly the easiest, from the increased leverage between the radius of the wheel and the radius of the axle.

(3708) P. Y. C. asks: Why does the moon appear to be convex, that is, after leaving full appear to have one side cut off, and as the line nears the center it becomes straight, when it again assumes a curved line, this time concave? Why does it not remain convex until new moon again? A. The phases of the moon are the same between the new moon and the full moon as they are between the full moon and new moon, only that they are reversed in position. This you can readily illustrate and prove by holding a white ball at arm's length and watch the phases as you turn round at a short distance from a strong light.

(3709) A. T. C. asks: Will you please give me a composition that will cause small stones, etc., to adhere, for about two months at least, to a wooden surface, and be able to stand some friction? A. There are several cements. Plaster of Paris makes a quick setting cement for stones. Easily applied. Asphalt is much used, but requires to be applied hot. Portland cement is also good, but does not set as quickly as plaster of Paris.

(3710) G. M. G. says: Will you give me a formula of paint for a tank (both wood and metallic) that will be durable and one that will not injure the water for house use? Also does galvanizing iron tank injure water for domestic use? A. Oxide of iron paint mixed with boiled linseed oil is the only suitable paint for water tanks, wood or iron. For iron tanks there should be not less than two coats, the first well dried before the second is put on. Use no turpentine. For wooden tanks a coat of boiled oil should be put on before the paint, and well dried. Water standing in galvanized iron tanks becomes impregnated with and tastes of the zinc. Such tanks should be painted with the oxide of iron paint.

(3711) H. L. says: I have an assorted lot of watch hair springs, that I have wrapped in paraffined paper, put that in a tin box (small) and that again in an impervious box. Still they have a tendency to rust. Is there anything in the paper (paraffine)? and could you give me a better way to keep them? A. If the paper is white, it may have been from stock bleached with acids or chlorine. Use tissue paper slightly moistened with watch oil, and put a small piece of quicklime in the box.

(3712) B. W. H writes: 1. I would like to ask in regard to 3377: What is the acid of cider other than acetic. Is it phosphoric or malic, as some old books give? A. Malic and phosphoric acid are both present in cider. The latter is probably combined with some base. 2. As to 3488, 3494, is there any direct connection between the velocity of electricity and conductivity? A. There is no direct relation. It is probable that when an electric current is started, a portion of its energy is transmitted with the speed of light, but it may take many minutes for the entire current strength to be felt at the end of a long line of high capacity. 3. Several years ago the SCIENTIFIC AMERICAN gave some elaborate details of bicycles (velocipedes). Have there been any recent articles on the modern machines? A. We refer you to our SUPPLEMENT, Nos. 691, 743; also, SCIENTIFIC AMERICAN, No. 18, vol. 64. 4. Is the difficulty of soldering aluminum with the solder or the flux? A. It is probably with the flux, although the actions are so interdependent that it can only be attributed to both. 5. What is the lowest temperature at which a "real" enamel will set, and composition of same? A. A mixture of 12 parts white fluorspar, 12 parts of unburned gypsum, and 1 part of borax gives a fusible enamel. There are many other formulas. The temperature you ask for cannot well be given, as it is rather indefinite.

(3713) A. B. C. asks: What are the proper ingredients required in mixing concrete to be used in building a small solid concrete house? Will ordinary stone lime be good enough to make the walls so that they will never crumble? Stone lime and lake shore gravel are both cheap here. Kindly give full directions for mixing so as to insure success. A. You cannot use lime to make concrete suitable for house walls or foundations with beach sand or gravel. Use hydraulic cement. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 285, "How to Build Concrete Walls," and No. 119, illustrating a concrete dwelling.

(3714) D. W. B. asks for the rule for finding the horse power of any steam engine, whether marine or stationary, and whether single acting, compound or triple expansion. A. The rules for computing the horse power of all kinds of engines will occupy more space and illustration than can be given in notes and queries. We refer you to the "Practical Engineers' Hand Book," by Hutton, $7, or "Roper's Engineers' Handy Book," $3.50.

(3715) E. B. S. asks what creameries or butter or cheese factories use to keep the odor and the taste of the wood from impregnating the butter or cheese. It occurs to me that a coating of tasteless paraffine wax would be a valuable aid in a case of this kind. A. Butter tubs are only washed with salt water and cheese boxes have no preparation. Should judge your suggestion a good one.

(3716) C. W. P. asks how to make a cement that will stand kerosene oil, and not leak or sweat through. A. Cement particularly adapted for attaching the brasswork to petroleum lamps is made Puscher, by boiling 3 parts resin with 1 part of caustic soda and 5 parts of water. The composition is then mixed with half its weight of plaster of Paris, and sets firmly in half to three-quarters of an hour. It is of great adhesive power, and not permeable to petroleum, a low conductor of heat, and but superficially attacked by hot water. Zinc white, white lead, or precipitated chalk may be substituted for plaster, but hardens more slowly.

(3717) S. R. S. asks if there is a mix-ture or composition that can be used on very fine cut crystals to give them the true luster, fire and sparkle of the real diamond. If it is a chemical liquid or compound, and how to apply, so as to give a lasting effect. Also what the composition is of the paste (so called) used to back cheap stones by the jewelry trade. A. There is no mixture or composition that can be applied to crystal of glass of any kind to impart to it the true luster or fire of the real diamond. It is said that some parties pretend to apply to glass a solution of diamond. In the first place it is impossible to dissolve the diamond to make a solution, hence it cannot be applied. In the second place many of these stones were not cut out of quartz crystals, but were common French paste, in other words lead glass, which may show some of the fire of the diamond, but has no durability, owing to its hardness not being greater than that of ordinary glass. There is no composition or paste that is called paste that is used to back cheap stones. The stones themselves are called paste. Pastes are frequently backed by means of small metallic caps containing mercury or they are coated with mercury amalgam, so as to impart to them a mirror like reflection.

(3718) J. A. S. asks: Will metallic zinc precipitate metallic iron in a solution of chloride and in a solution of protochloride of iron? A. It will not.

(3719) J. E. asks how to dissolve celluloid into a liquid? A. Amyl acetate is a well known solvent. A mixture of alcohol and ether, and many other substances, may also be used.

(3720) S. G. H. writes: A, B and C draw lots to see which shall do a certain piece of work. A and B draw first. A wins and retires, leaving B to draw with C, who loses and does the work. What was the chance of each in such a scheme? Is the following problem similar to above: A, B and C have equal claim to a prize. A says to B, you and I will draw lots and the winner shall draw lots with C for the prize. The answer as given for this is A ¼, B ¼ and C ½. A. In the first case, in the actual drawing, B has twice the chance that A has, as he draws twice against a single competitor. The answer might be put: A=½, C=1, B=1. Originally the chances of A and B are even and each has one-half the chance of doing the work that C has. This would give A=1, B=1, C=2. This answer corresponds with that of the second problem. They are really identical.

(3721) W. E. asks the meaning of the initials J. B. L. on the face of each twenty dollar gold coin. A. The small letters seen sometimes on coins are often the initials of the die cutter. Thus on the silver dollar a very minute M is to be seen on the base of the neck, which indicates "Morgan." The initials J. B. L. which you speak of are undoubtedly those of J. B. Longacre, who some years ago was United States mint engraver attached to the Philadelphia mint. Sometimes the small letters denote the mint at which the coin was struck.

(3722) T. A. A. asks how many (or about) cubic feet of gas it will require to lift one hundred pounds, and whether hot air has the same buoyancy as gas. A. Pure hydrogen gas will lift about 70 lb. to 1,000 cubic feet, or 100 lb. to 1,429 cubic feet; street gas will lift about half as much. Hot air as used in balloons has less lifting power on the average.

(3723) C. M. S. asks: 1. Will you please tell me how the torpedoes used by children on the Fourth of July are made—what the chemicals are, etc.? A. They consist of a minute quantity of fulminate of mercury mixed with gravel and twisted up in thin paper. 2. Will you please tell me of some book like a dictionary, that tells how the different chemicals are made? A. We can only refer you to general chemistries, such as Fowne's or Roscoe's chemistry. All such we can supply by mail.

(3724) J. B. T. writes: Having been a soldier for twelve years and over, I have tried to discover some preparation that would give leather a black, shiny gloss or varnish, something that would last for a while without requiring continual working. Can you give a receipt for it? A. The only effectual way is to regularly japan the leather, making what is known as patent leather. A solution of shellac in ammonia is sometimes used for leather. This might be mixed with a good black pigment. Long standing is required to effect the solution.

(3725) B. W. J. asks: 1. How can a watch be demagnetized by means of a dynamo? A. A watch can be demagnetized by tying it to a string, twisting the string, allowing the watch to be whirled by means of the string as it is moved forward toward the poles of the field magnet, and then withdrawn. 2. Could a Rhumkorf coil be made to run incandescent lights? Please give directions for one that would run about 3 sixteen candle power lamps. Could you attach it to an incandescent circuit? To settle a discussion, would one thus connected require as much current (by meter) to run three lamps as the lamps would if connected direct? A. Incandescent lamps cannot be operated by means of the Rhumkorf coil. The coil can be operated by connection with an incandescent circuit. As the lamp cannot be run in this way, the latter part of this question does not admit of an answer. 3. What would you advise a young man to study for, either electrical or mechanical engineer? A. A knowledge of either electrical or mechanical engineering should be acquired by a course in some school of good standing. If you mean to ask which of the two professions is preferable, we would reply, choose the one most in accord with your natural inclinations.

(3726) C. J. R. asks: 1. How many candle power of incandescent light would it take to light a room 8 feet long, 8 feet wide and 6 feet high? A. A 10 candle power lamp would answer for a room of the size mentioned. 2. How many cells of battery would it take to run that number of candle power lamp? A. It will require about six cells of large Bunsen battery to run such a lamp. 3. How often would it be necessary to refill the cells, providing I use the light an average of three hours a day? A. The Bunsen battery requires renewal once a week. 4. What substances shall I use to make the solution for the cells? A. Use a bichromate solution. Consult any work on batteries, or SUPPLEMENT, Nos. 157, 158, 159, and 792 for information on batteries. 5. What is the best kind of wire to use between the batteries and the lamps? A. No. 18 office wire will answer for the leads.

(3727) G. S. P.—Harness polish is made by breaking 4 ounces of glue in pieces and pouring over it 1 pint of vinegar. This is allowed to remain until perfectly soft, then make another solution of 2 ounces of gum arabic and half a pint of black ink. To mix add another half pint of vinegar to the glue solution over a moderate fire, but do not let it boil. When it is dissolved add the gum solution, keep at a temperature of 180° Fah., and further add 2 drachms of isinglass in a little water, then remove from the fire and draw off for use. It is to be applied by a sponge, and a very thin coat given, allowing to dry quick, which gives a better polish.

(3728) W. H. R. asks: 1. Will an alter-nating current do as well as a continuous current for lighting incandescent lamps? And what is the difference, if any? A. The alternating current is extensively used for incandescent lighting. 2. Which is the more saving in carbons in the arc lamp, the alternating or continuous current? A. There is practically no difference. 3. What is the principle of the multiphase dynamo, or generator, used at Lauffen, which sends the current to Frankfort? And also the multiphase or rotary current motor? A. These are described in SUPPLEMENT, No. 825.

(3729) W. G. says: 1. Can you tell me how to make a paint for barrel heads, bright and glassy? A. Mix the colors with quick drying varnish. 2. Can I make a mould of a china ornament to cast from again, and how and of what material? A. You can mould the ornament in fine loam, such as used by brass founders; or if you want to make a pattern from the ornament, oil it and make a mould of plaster of Paris, in which you can cast a pattern with type metal. 3. Receipt for good heavy whitewash. A. For a brilliant whitewash. To a half bushel of best lime slaked in hot water, add 8 quarts of salt dissolved in hot water, 2½ pounds ground rice boiled to a thin paste, stirred in boiling hot, also 1 pound clean glue dissolved in hot water, and ½ pound fine whiting, with hot water enough to make the whitewash spread properly with a brush. Let it lie for a day or two and then apply hot.

(3730) J. J. M. asks: What hydrometer is the best to test silver solution with and what is the standard on same? Also a receipt of a good tin oxidizer, also a receipt of a nickel oxidizer? A. Baume's hydrometer is the best. Silver solutions vary by the use of the bath. You will have to gauge the condition of the bath by trial. Tin and nickel do not make oxidizing surfaces. To oxidize they must have a thin deposit of silver and the silver must be oxidized by sulphide of sodium bath.

(3731) J. T. N. asks: Can a force pump be placed at my house, 88 yards from and 22 feet above the level of my spring, connected with spring by a pipe and draw water from it? I am afraid my spring is not strong enough for a ram, and see no other way to get the water. Can you advise me? A. You can pull the water the distance and height named, if you cut a ditch a few feet deep into a recess in the ground at the pump, so as to use a subchamber pump, and lessen the height of lift say to 17 or 18 feet, you will have little or no trouble in keeping the pump charged. Suction pipe should be perfectly tight, with a foot valve at the spring.

(3732) T. A. B. asks: What material can be applied to cement floors now laid to make them absolutely waterproof and proof against sewer and other gases working through them, and not act injuriously on the cement? What material can be mixed with cement, or other material, to accomplish same result in laying new floors? Material must be capable of withstanding as much wear as ordinary cement floor and be comparatively inexpensive. A. There is nothing cheaper or better than coal tar applied to the cement floor to make it water and gas proof. Make the coal tar thin with turpentine, so that it will not only strike into the cement, but may be easily brushed on with a large brush (whitewash brush). Apply 2 or 3 coats, letting each dry before the next coat is applied. We recommend the same for new floors to be made of Portland cement. When worn a fresh coat can be put on.

(3733) E. B. U. says: A few days ago we accidentally overturned a kerosene oil lamp on a figured Brussels carpet. Can you tell me through your query column in the SCIENTIFIC AMERICAN of any receipt which will take out, if not all of it, at least some of the kerosene, and not take out the colors in the carpet? I find that your receipts in that column are very useful, and have a note book into which I copy most of them. A. Expose the carpet to heat. For example, hang the carpet before a grate fire, as close as possible without burning, until the oil is evaporated. This is an effectual method.

(3734) S. M. writes: Do you know of substance which will make silicate of soda insoluble in water? I wish to use a water solution of silicate of soda with asbestos, the former to be the binder, but after drying and pressing the mixture, water will again act on the silicate of soda. A. You cannot make it completely insoluble. By baking you can make it less soluble than it normally would be, but complete insolubility cannot be imparted to it.

(3735) A. A. U. writes: My house has been recently shingled with (white) cedar shingles, and the cistern water is about the color of good coffee. It is very disagreeable to use and is coloring the clothes. Is there anything I can put in to take out the color? We have had a big rain and have a winter's supply. A. Nothing can be done. After a time the shingles will cease coloring the water. Empty the cistern and the next supply will not be so bad. It will not be clear for several months.

(3736) W. A. H. asks for a formula for making an explosive that is mild in power and loud in report when not confined. Wish to use same on light tapers, cigar lighters. A. Fulminate of silver explodes by heat, it can be used on trick matches, but it is very dangerous and is exceedingly powerful. Iodide of nitrogen answers your description better, but is almost spontaneously explosive. The combination you ask for is unattainable.

(3737) J. W. A. asks: Can water be heated above 212° Fah.? A. Water cannot be heated above 212° Fah. in an open vessel, but in a closed steam boiler the water may be heated much higher. For example, in a locomotive boiler at 150 pounds pressure the water has a temperature of about 363° Fah.

(3738) G. W. T., Jr., says: I am con-structing a gas generator on a small scale and intend to use a dentist's gas blow pipe. Will you oblige me by answering or giving me any information in regard to the following: 1. Can gasoline gas generated by forcing air through the liquid and pumped into a gasometer be used the same as artificial gas used in cities (coal gas)? 2. Has it the same degree of heat? If not, can it be used successfully with a blow pipe to solder 20 carat gold? 3. Would heating the gasoline by setting it in hot water aid its combustibility? 4. Will gasoline gas remain unchanged for an indefinite time, if kept in a gasometer surrounded by water? A. Gasoline vapor and air should not be stored in a tank. There are possibilities of disastrous explosion. By passing air from holder through a small vaporizing pan with a large evaporating surface, so that there will be an excess of gasoline vapor, there will be less danger, as this method is used for lighting. A saturated vapor will operate with a blow pipe for the purpose desired, but will be more smoky and give more trouble than an oil lamp. Hot water will facilitate evaporation, but the excess will condense in the cold pipes and cause trouble. For ordinary dental purposes there is nothing better or safer than an alcohol lamp and blow pipe where there is no gas.

(3739) D. E. S. says: 1. On page 119 of SCIENTIFIC AMERICAN of February 21, 1891, it speaks in an article of a Serpollet generator. Please explain them and the principle involved. Are any made in this country and where? A. The Serpollet generator is an iron pipe flattened and coiled. The water is injected into the coil only as fast as wanted for steam. The walls of the coil are so close that the water does not enter into the spheroidal state. They are described and illustrated in our SUPPLEMENT, Nos. 722, 746, and 751. They are made in France. 2. What is a naphtha engine and how does it differ from a gas or gasoline engine? A. A naphtha engine uses vaporized naphtha instead of steam, which is condensed by exhausting into a surface condenser and returned to the boiler. 3. How is the steam condensed in a condensing engine? A. In a condensing engine the steam is exhausted into a condenser or chamber, meeting a jet of cold water, the water and air being pumped out. 4. Has either a gas, naphtha, or steam engine been described with a view of amateurs building them? A. We can mail "Model Engine Making," by Pocock, $1, and "Gas Engines," by Clark, $2.50. 5. Could double the amount of power be got out of a given amount of steam by having two pistons in a cylinder, one at each end? What would be the result of such an arrangement on a gas engine? A. You cannot add to the power of a given amount of steam or gas by using double pistons.

(3740) A. R. L. asks: 1. I have precipi-tated the gold from several toning solutions with $FeSO_4$ and afterward dissolved with nitro-muriatic acid. Immediately upon adding some of the solution after being evaporated and redissolved, a yellow precipitate was formed and the prints would not tone. The baths used contained some sodium salts. A. The trouble was probably in the evaporating. Evaporation to dryness partly decomposes gold chloride. Evaporate repeatedly with successive additions of water, to sirupy consistency only and on a water bath, not directly over the flame. The object of this treatment is to expel all acid. 2. Would also like to know of an easy way in which the skin and flesh can be removed from a cat's head, to obtain a good skull. A. The approved method is by soaking for several weeks in water, washing in warm water until perfectly clean and bleaching in chloride of lime water. One teaspoonful of the salt to a pail is enough. This is slow and very disagreeable. You may instead boil the head until the flesh all comes away; after drying, soak in weak lye, wash, and bleach with chloride of lime water. The time of boiling and of bleaching depends on the specimen. Use judgment.

(3741) I. F. C. says: This town has waterworks. I do not know what style to call them, only, the water is forced direct from a large spring at lowest part of city. There is no water tower, standpipe nor anything of that kind. There is a reservoir used in case of fires. Now, here is the trouble: When pressure is applied on the pumping apparatus, above what is usual, there is a great knocking and pounding of pipes in dwellings and business houses, at every revolution of the pumping machinery, which is very annoying, and I wish to know if there is not some way of stopping the nuisance. All you can get out of our city authorities is, "It's air in the pipes." If that be the case, cannot it be remedied, and is it not ignorance on the part of the engineer or water works management? A. We should judge that there is want of air in the right place. With proper air chambers at the pumps, on both suction and force pipes and small air chambers at the ends of the pipes and above the bibbs in buildings, there should be no noise at any time. If there are invert siphons in the mains, there should be taps to draw off air at such places.

(3742) E. B.—To reduce over-dense ne-gatives make a solution of hyposulphite of soda, 10 grains to the ounce of water, and dissolve therein from 10 to 30 grains of ferridcyanide of potassium. Use at once, as the solution deteriorates rapidly. Retouching varnish is made as follows:

Alcohol	300 parts.
Sandarac	18 "
Camphor	5 "
Castor oil	10 "
Venetian turpentine	5 "

(3743) J. H. S. asks how to dye or stain bone and horn black. A. Apply a solution of nitrate of silver and expose to the sun. The solution is applied several times to the article to be stained, but it is necessary the first coat should be dry before another is applied.

(3744) R. J. G.—Diamond ink is made by mixing with hydrofluoric acid enough barium sulphate to give it consistency, so that it will not spread, and show well on the glass. Ammonium fluoride may also be added. After the writing has stood some time it is washed or dusted off, and the etching appears. The materials are easily obtained of any dealer in chemicals. Hydrofluoric acid is poisonous and the fumes should be avoided. It should be kept in a lead or gutta percha bottle.

(3745) A. B. asks: 1. What is meant by equivalent focus and back focus? A. Equivalent focus is the focus due to the distance of the object focalized, and usually called the conjugate focus. The back focus is only another name for the conjugate focus, all being beyond the principal or focus for parallel rays. 2. Give formula for good toning solution.

A. Chloride of gold	1 gr.
Acetate of soda	30 "
Water	8 oz.

3. What is the use of French azotate? A. It takes the place of acetate of soda in the toning bath. 4. In what number of SUPPLEMENT or regular edition will I find best directions for making camera for 2¼×2¼ inch plates? A. For illustrated description of camera bellows, see SCIENTIFIC AMERICAN SUPPLEMENT, No. 625, also SCIENTIFIC AMERICAN of October 13, 1888, page 231. 5. What is size in fraction of inch of $\frac{f}{32}$ stop? A. The size of the stop is the focus in inches divided by 32; for instance, if the focus is 8 inches, then $\frac{8}{32}$ is 0·25, or a ¼ inch stop.

(3746) Enquirer asks: If galvanized iron roofs are suitable for a foundry, are such roofs liable to oxidise from condensation, coming from the heated gases and steam in the foundry? A. Iron roofs are in use for foundries. If well painted on the under side, they do not oxidise more than for other buildings. Galvanized sheet iron is largely used for covering. It wears

well, but as the fault of condensing steam or moisture on the under side in cold weather and interferes with the moulding and pouring by dropping water where it is not wanted. We recommend slate on iron frames as best and safest.

Replies to Enquiries.

The following replies relate to enquiries recently published in SCIENTIFIC AMERICAN, and to the number therein given:

(3627) **A. T. writes in answer to H. D. G.** I use 11 cells Julien 5 S type storage and charge with 44 cells gravity, all in series. Have four 16 candle power and three 12 candle power 20 volt Edison lamps. Conductors No. 10 and 12 B. and S. gauge wire. Have not been very successful, owing to great consumption of bluestone and large deposit on zincs. I tried the forms of gravity now sold with porous cups and found them a great improvement, but charging current is so low, could only burn one 16 candle power lamp for three or four hours, or say 18 to 20 hour charging. [The deposit of copper on the zincs, if occurring while charging, is due to insufficient current. If you had 52 gravity cells in two parallel series, the result would be much better, as nearly twice the current would pass. This is on the assumption that the deposition of copper occurs during the charging. If, however, your battery stands long on open circuit, the trouble will inevitably occur. Only plan would be to have some arrangement for drawing off the upper two inches of solutio from the cells when not charging. Forty-four gravity cells on 11 storage cells gives an unnecessarily high voltage. To use that number, place 8 cells in series and place the other 36 in 2 in parallel and 18 in series.—ED.]

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AND EACH BEARING THAT DATE.

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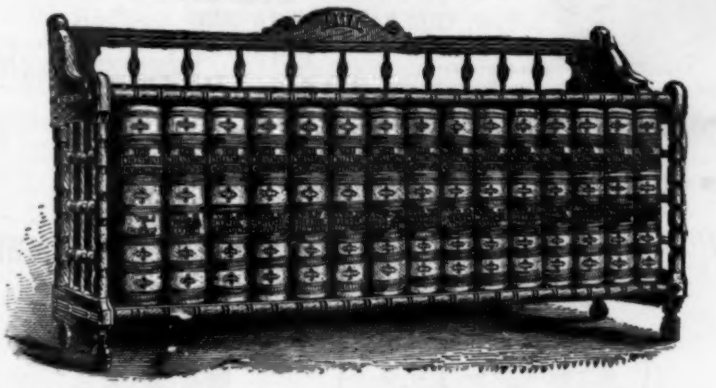

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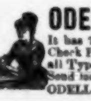

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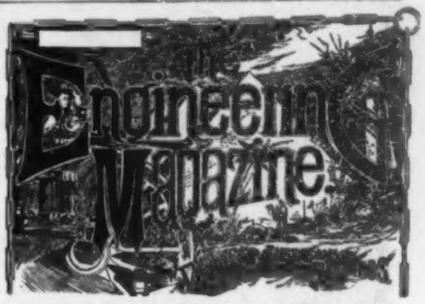

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In other respects the December number is a specially strong one, the leading articles being: "A Permanent Census Bureau," by Edward Atkinson; "Fulton Night with the Mechanical Engineers;" "Geology from a Business Point of View;" "The Suburban Railway Station;" "Landscape Beauty at Newport;" "The Manchester Ship Canal;" "Pure Water and Public Health;" "The Conditions Causing a Cold Wave;" and "The Canadian Pacific Railroad;" Editorial Departments; Index to Engineering Press: Popular Miscellany.

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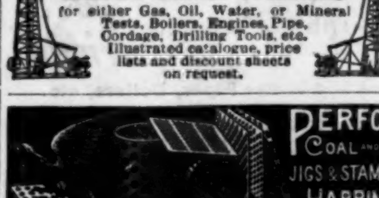

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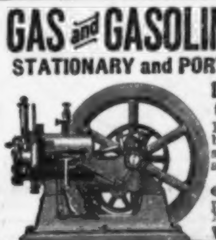

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